

Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

Copy 1

UNITED STATES DEPARTMENT OF AGRICULTURE
MISCELLANEOUS PUBLICATION No. 101

WASHINGTON, D. C.

JULY, 1931

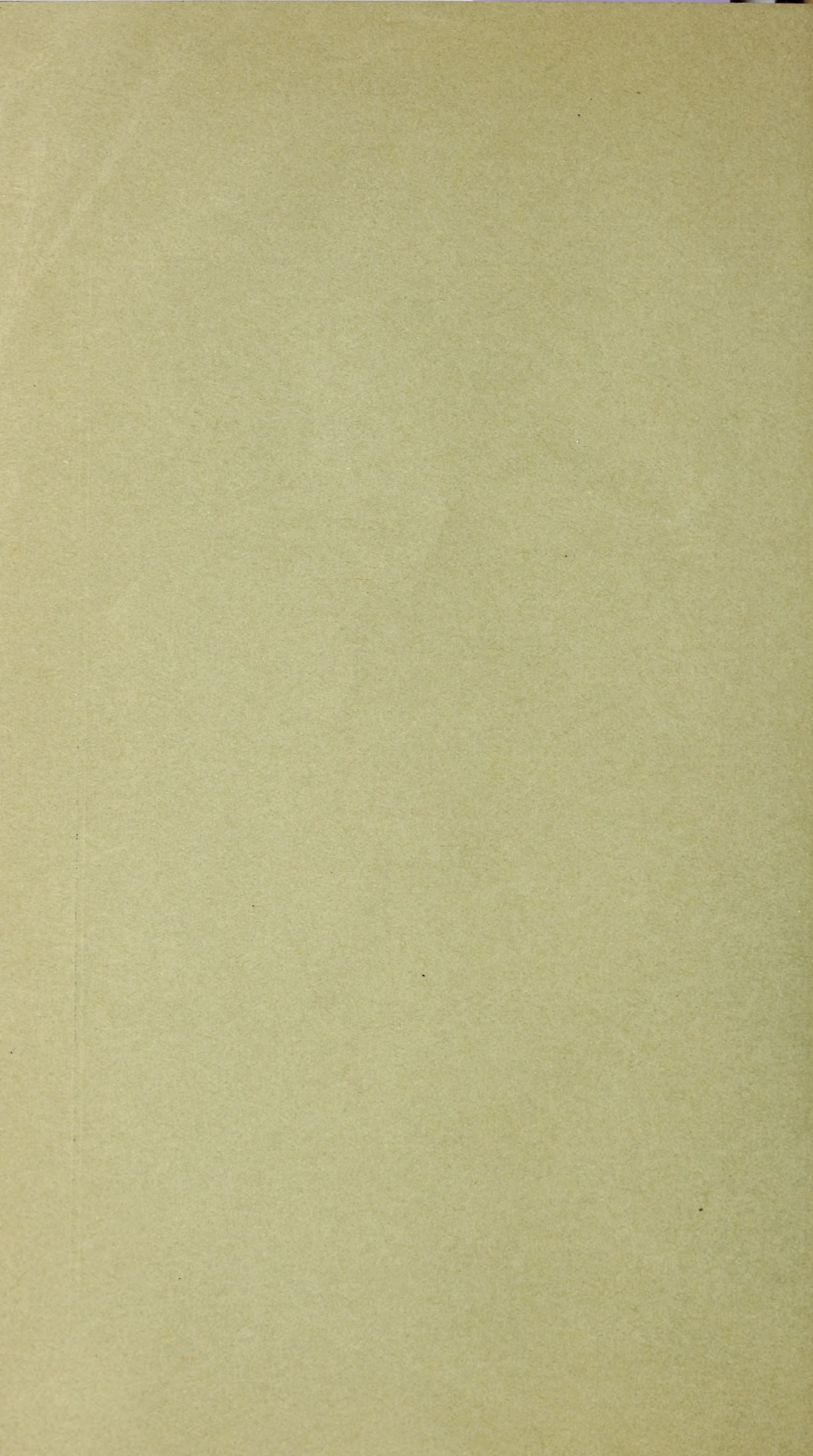
**IMPORTANT WESTERN BROWSE
PLANTS**

By

WILLIAM A. DAYTON

Plant Ecologist, Branch of Research
Forest Service





UNITED STATES DEPARTMENT OF AGRICULTURE
MISCELLANEOUS PUBLICATION NO. 101

WASHINGTON, D. C.

ISSUED JULY, 1931

IMPORTANT WESTERN BROWSE PLANTS

By WILLIAM A. DAYTON,

Plant Ecologist, Branch of Research, Forest Service

CONTENTS

	Page		Page
Importance of browse on range-----	1	Classification of western browse species by miscellaneous uses or properties-----	179
Palatability of browse-----	4	Literature cited-----	180
Important western browse families, genera, and species-----	6	Index-----	190

IMPORTANCE OF BROWSE ON RANGE

The term "browse" has a double significance. Its primary meaning is shoots or sprouts, especially of tender twigs and stems of woody plants, with their leaves, as cropped (browsed) more or less by domestic and wild animals. Browse is also a generic term, applied to shrubby, woody vine, or small tree vegetation, whether palatable or not, forming one of the four main groups into which range vegetation is popularly divided, the others being grasses, grasslike plants (i. e., sedges and rushes and their allies), and weeds (i. e., nongrasslike herbs).

It is impossible to state exactly how many browse species occur in the United States, or even in the West; the number, however, for the United States, runs easily into the thousands. During the past 22 years approximately 1,000 species of shrubs, undershrubs, and woody vines, embracing 225 genera and 68 families, have been collected on national forest ranges by forest officers, and this number is being continually augmented. Large areas of national-forest and other land of the West remain practically unexplored botanically.

Western shrubs are enormously varied in their distribution, being found from the seashore (and below sea level in such depressions as Death Valley) to timber line and, greatly depauperate, of course, at the very limit of vegetation on the high mountains; they occur in the most arid places where vegetation will endure and also in the wettest of sites such as water-logged bogs. Very few forms of plant life will endure a greater degree of alkalinity or salinity than will certain shrubs, and, on the other hand, various bushes are commonly met with in the richest humus. It is impossible to give the exact acreage

occupied by shrubs in the Western States, but it undoubtedly runs into nine figures (102, 120.)¹ There are millions of acres of the chaparral types in California alone; the sagebrush formation characterizes the landscape of vast portions of the Great Basin and the Rocky Mountain region generally, while the tremendous wastes of the southwestern desert support numerous highly specialized types of shrubby plants. On the basis of Shantz and Zon's natural vegetation map of the United States (120, *pt. 1, sec. E*) the areas of the five essentially browse types of the West are as follows:

	Square miles
Sagebrush.....	213, 646
Creosote bush.....	133, 872
Piñon-juniper.....	129, 711
Greasewood.....	19, 551
Chaparral.....	17, 980
Total.....	514, 760

Shrubs frequently grow in pure or nearly pure stands, forming a distinct shrubby type of vegetation; even more commonly, however, they occur in conspicuous admixture with other plants; for example, as an understory in forests or as more or less scattered individuals in grass or weed types in parks, on foothills, and on mountain slopes. In the mountain regions of the West shrub types are often met with at the lower elevations, as on the foothills and lower plateaus, above or near timber line, on southerly or easterly slopes, or on burns and in alkali basins. In regions of too great aridity, coolness, evaporation, or alkalinity to support tree growth shrubby formations are commonly encountered.

Students of plant distribution and succession are wont to disregard shrub associations, in favor of trees or grasses, in designating climax or permanent types of vegetation, but there are numerous and important instances where shrubs constitute a permanent type. There is no question as to the stability and permanence of the shrub type of vegetation on huge areas of the Western States.

Harshberger (57), who has made the fullest account of plant distribution in North America, discusses over 30 essentially shrub formations in the West. These are:

Sand-hill territory

Amorpha (leadplant)-Prunus (sand plum)-Ceanothus association, in the sand hills.

Foothill district

Sage formation.

Greasewood-Eurotia formation.

Mountain-mahogany scrub formation.

Southern Park mountain district

Meadow-thicket formation.

Oak-mountain-mahogany formation (foothill thicket at eastern base of the mountains).

Willow-birch bog formation.

Rocky hills formation.

Black Hills area

Limestone-table-land formation.

¹ Italic numbers in parentheses refer to Literature Cited, p. 180.

Great Basin region

Sage-greasewood formation.
River bottom-meadow formation.

Arizona-New Mexico district

Desert-plain formation.
Dune formation (New Mexico).
Bolson-basins formation.
Lava-beds formation.
Coleogyne (blackbrush) formation.
Piñon formation.

Mohave district

Covillea (creosote bush) formation.
Salvia (true sage)-Ceanothus association, in the piñon-juniper formation.

Columbian region

Salal formation.
Silver sage formation.
Ledum-bog formation.

Californian region

Dune formation (bearberry, shrub lupine, etc.).
White ash plain formation.
Bog formation.
Redwood slopes and flats formation (containing a copious association of shrubs as an understory).
Chaparral formation.

San Joaquin district

River-bank formation.

Sierra area

Foothill formation (chaparral).

Coastal territory

Chaparral formation.
1. Mountain facies.
2. Foothill facies.
Cañon formation.

San Jacinto territory

Mesa formation.
Chaparral formation.
Alpine formation.

Clements (20) recognizes 20 climax plant formations on the North American Continent, of which 6 are represented by western shrubs. These are:

Foothill chaparral: *Ceanothus-Quercus-dryon*.
Desert chaparral: *Prosopis-Covillea-eremion*.
Thorn scrub: *Cereus-Fouquieria-eremion*.
Desert scrub: *Atriplex-Artemisia-halion*.
Arctalpine scrub: *Betula-Salix-helion*.
Heath: *Ledum-Vaccinium-oxyon*.

While not, of course, of forage value equal to the grasses, browse is of enormous importance to the livestock industry under western range conditions, and especially in times of drought and other occasions of feed shortage. Roughly speaking, of the browse species so far collected on national-forest ranges, only about 1 in 18, or 5.5 per cent, possesses very considerable forage value, but the number that are grazed to some extent, at least under certain circumstances, is very great. Only about 30 species of these shrubs, or 3.15 per cent, appear to have been poisonous to livestock, but a

number of others may possibly be so. In addition to their value as browse for livestock, shrubs on the range frequently have other values, such as utility for watershed protection and wild-life conservation, poisonous or medicinal properties, cordwood, edible fruits or nuts, latex, and as indicators or "ear marks" of overgrazed range, planting sites, and potential agricultural land.

It is important that a reasonably intimate knowledge of western range shrubs should be shared by range administrators and stockmen, to the end that such knowledge may form a basis for the better and proper management of both range and stock in all cases where shrubby growth constitutes a material portion of the vegetative stand.

This publication, which is issued as a general treatise for forest officers and stockmen, gives a brief survey of the more important western browse plants and their rôle in range management. The data given represent extensive investigations by many members of the Forest Service as well as by the author, and appreciation of the help received is gratefully acknowledged.² It was James T. Jardine, now director of the Oregon Agricultural Experiment Station, who as the first chief of the office of grazing studies in the Forest Service initiated and encouraged the collation of forage data on national-forest range plants. Of the army of national-forest range plant collectors (about 1,100 in number) indebtedness is due in no small measure to 52 men,³ each of whom has collected upward of 200 annotated specimens of record in the Washington office of the Forest Service.

PALATABILITY OF BROWSE

The use of the term "palatability," as found in this publication, is in accordance with the usage of national-forest range reconnaissance, and has been defined (*136, p. 14*) as—

the degree to which the herbage within easy reach of stock is grazed when a range is properly utilized under the best practicable range management. The percentage of the readily accessible herbage of a species that is grazed when the range is properly utilized determines the palatability of the species.

² Authority for the botanical identifications resides in the Office of Botany, Bureau of Plant Industry, U. S. Department of Agriculture (Frederick V. Coville, principal botanist, in charge), the bulk of the determinations having been made by Ivar Tidestrom (and up to 1914) by the late Edward L. Greene, with the advice of specialists in certain groups: F. V. Coville (heaths, huckleberries, currants, and gooseberries), C. R. Ball (willows), W. W. Eggleston (hawthorns), and S. F. Blake (composites). Paul C. Standley, formerly of the U. S. National Museum, has determined much of the material from New Mexico and Alaska. The writer is particularly indebted to Doctor Coville for the critical review he has given to the English plant nomenclature and to D. A. Shoemaker for numerous valuable comments made by him in reviewing the manuscript. The drawings, made especially for this bulletin, were the work of A. E. Hoyle, of the Forest Service; Figures 5 and 16 were drawn by N. W. Brenizer.

³ Douglas C. Ingram, William R. Chapline, Frank B. Lenzie, James T. Jardine, Frank H. Rose, Bryant S. Martineau, Leland S. Smith, Jesse L. Peterson, Alfred E. Aldous, F. G. Renner, C. L. Forsling, John H. Hatton, Fred D. Douthitt, Robert R. Hill, Arthur W. Sampson, William N. Sparhawk, C. E. Taylor, Charles E. Fleming, M. W. Talbot, Lee O. Miles, Charles H. McDonald, John C. Kuhns, Fred P. Cronemiller, C. H. Hurst, Arthur D. Read, E. Grandjean, J. A. Willey, Earl V. Storm, Harold D. Foster, H. B. Maris, Arnold R. Standing, Jack Magee, Orange A. Olsen, George E. Moore, C. N. Woods, Lenthall Wyman, Waldo D. Barlow, Lynn H. Douglas, Paul B. Lister, C. K. Cooperider, Harley J. Helm, W. J. Sproat, Robert F. Copple, Charles H. Flory, H. L. Smith, Ivar Tidestrom, Thomas Lommasson, Harry S. Yates, C. F. Korstian, Frank F. Liebig, James C. Whitham, and Philip V. Woodhead. Among those forest officers who have not collected as many as 200 specimens many have made important contributions to our knowledge of western range plants and their value. In this category special mention seems due to the following: Mark Anderson, Nelson Jay Billings, Lee P. Brown, James A. Cahill, Robert S. Campbell, H. O. Cassidy, Matt J. Culley, Charles DeMoisy, jr., H. R. Flint, Leon C. Hurtt, Louis Knowles, Harry E. Malmsten, William H. Mast, Agnes D. McNair, Enoch W. Nelson, A. A. Saunders, Jacob D. Schoeller, David A. Shoemaker, James O. Stewart, Robert Thompson, and Herman Work.

The palatability applies to the growing season of the vegetation in which the species in question occur and, in some cases, to the yearlong season.

The following palatability tabulation, developed by W. R. Chapline, has been followed in this work:

	Per cent
Practically worthless-----	Less than 5.
Poor-----	5 to 15.
Fair-----	20 to 35.
Fairly good-----	40 to 50.
Good-----	55 to 70.
Very good-----	75 to 85.
Excellent-----	90 and over.

In developing statements of palatability, references to use of species on overgrazed range have largely been eliminated. There are many records, in print and unpublished, of extensive utilization of various unpalatable and distinctly inferior species which investigations of the Forest Service show are the result of overgrazing or otherwise exceptional conditions.

No rule of thumb can be promulgated by which a good browse species can be told from a poor one; like the pudding in the familiar adage, the proof of the good browse species rests primarily in the eating of it. In general, stock exhibit a preference for the relatively more succulent species and those with larger and thinner leaves. Few species of western shrubs with linear or threadlike (filiform) leaves are extensively browsed, although some very important forage species have compound leaves divided or dissected into linear or otherwise narrow segments. The species with leaf blades of a broad type—oblong, oval, rounded, etc.—are much more likely, other things being equal, to be superior in palatability and amount of forage produced. Such qualities of leaf are, of course, frequently closely connected with the habitat factors of light and moisture; the larger-leaved species, especially if the foliage is relatively thin, are more apt to be found in the moister and more shaded localities.

When true desert conditions are reached the leaves are frequently lost altogether or become rudimentary and abortive, and the shrub carries on its food-producing functions by its stems either exclusively or chiefly, as in cacti, ephedras, canotia, paloverde, forsellesias, and numerous other drought-tolerant (xerophytic) plant groups. There is a marginal zone beyond this desert association (eremion) of leafless shrubs, wherein numerous species are found with narrow, folded leaves the tissues of which are developed in every way to retard transpiration, or loss of water vapor; such species are, with but a few notable exceptions, low in the scale of palatability if palatable at all.

Shrubs with leathery, evergreen (coriaceous, or sclerophyllous) leaves are, in general, markedly less palatable than those with thinner and more delicate foliage. There are, however, exceptions to this rule, notably in the Southwest, where some of the best browse species, such as jojoba (*Simmondsia*) and gray oak (*Quercus grisea*) have thick, persistent leaves. Foliage of this character is usually typical either of a dry, sunny open site, or else of water-logged, boggy, and highly acid situations; on wet and acid sites the species are frequently members of the heath family (*Ericaceae*); these are likely to prove poisonous if grazed by stock.

In the Southwest and in the southern Great Basin region numerous shrubs with slender, decidedly green twigs are palatable; the stems of such plants, often being the chief place of food manufacture and storage, are nutritious as well; examples of this sort may be seen in jointfir (*Ephedra*), paloverde, etc.

Plants with bland juices, such as are customary in the rose and mallow families, are, other things being equal, much more apt to be cropped by stock than are species belonging to families with an acrid, intensely bitter, or astringent sap, such as, for example, the buttercup (crowfoot), dogwood (cornel), or spurge families. There are, however, notable cases of bitter-tasting shrubs which are palatable to stock; for example, bitterbrush (*Purshia*) and cliffrose (*Cowania*). Both have decidedly bitter-tasting foliage, but both are highly palatable and important browse plants; it is noteworthy, however, that the two genera mentioned belong to the rose family, a group which, in view of its immense size, is singularly free from poisonous properties.

Although, within rather narrow limits, taste gives us a certain clue to what is palatable or unpalatable to livestock, it is evident that there are chemical distinctions in bitterness, somewhat ill defined or not distinguished at all by the human palate, that register very definitely with browsing animals, causing them to reject some types of bitterness, while apparently relishing others.

The distinctly saline taste exhibited by many shrubby plants, especially of the goosefoot family, growing in alkaline or saline situations, is in general agreeable to stock. Herbage of pronounced acidulous flavor appears to be seldom relished by grazing animals. It is very doubtful also whether any western shrub with a milky juice is palatable to livestock.

The presence of disease, such as rusts, is another factor which affects the value of forage, often greatly reducing the palatability and quantity of the herbage produced, and sometimes causing sickness and losses.

IMPORTANT WESTERN BROWSE FAMILIES, GENERA, AND SPECIES

A truly excellent browse species may be said to have the following characteristics:

- High palatability and nutritiousness.
- Abundance on the range.
- Wide distribution.
- Height (within the reach of livestock).
- Abundance of herbage.
- Ability to withstand grazing (size and extent of root system; vigor and aggressiveness, etc.).
- Reproductive power, sexual and vegetative.
- Freedom from spines, awns, burs, or other anatomical processes injurious or annoying to grazing animals, or impairing the value of the animals' wool, mohair, or pelt.

The browse crop on western ranges is largely produced by about 24 plant families and 60 genera, although at least half of the total number of shrubby species are of appreciable browse importance there. At least 6 families and 17 genera are poisonous. The families, genera, and species noted in this publication are selected on the

basis of 22 years of national forest-range plant collection and annotation, supplemented by material in the publications shown in the lists of literature cited and other publications. The selection is admittedly not exhaustive, and further research may bring to light other range shrubs of an importance amply justifying treatment in a work of this sort.

Other families are included in the body of the publication which are of minor or no value as forage but are important because of their abundance, poisonous properties, or some other specific reason.

Nine plant families of outstanding importance and interest as western browse are: The rose family (Rosaceae), including the apple (Malaceae) and almond (Amygdalaceae) families of so many present-day botanists; bean or legume family (Fabaceae or Leguminosae), including the mimosa (Mimosaceae), cassia (Caesalpiniaceae), and ratany (Krameriaceae) families of the later botanists; aster, or composite family (Asteraceae or Compositae) in a broad sense; goosefoot family (Chenopodiaceae); buckthorn family (Rhamnaceae); oak family (Fagaceae); honeysuckle family (Caprifoliaceae); willow family (Salicaceae), and heath family (Ericaceae). The greater number of the more important, widely distributed, key groups of browse belong to the first eight families enumerated above. The ninth family is of particular importance as containing many stock-poisoning shrubs, a very important characteristic also of the legume and composite families.

The rose group (Rosaceae) is, with the possible exception of the composites, the most widely developed shrub family in the West and, all things considered, is perhaps the most important as range browse. It contains a very considerable number of excellent forage shrub species, such as mountain-mahogany (*Cercocarpus*), bitterbrush, cliffrose, Apache plume (*Fallugia*), and rose (*Rosa*). On the other hand it includes a number of at best only slightly or moderately palatable shrubs such as ninebark (*Opulaster*), the spireas (*Spiraea* and *Sericotheca*), and most of the thimbleberry-blackberry-raspberry alliance (*Rubus*); also several genera that are usually either absolutely or almost worthless from the grazing standpoint, such as chamiso (*Adenostoma*), bearmat (*Chamaebatia*), blackbrush (*Coleogyne*), sibbaldia, and vauquelinia.

The apple and peach families, treated in most of the older and in a few of the modern manuals as subfamilies of the rose family, contain a considerable number of valuable browse genera. Among such may be mentioned at this point serviceberry (*Amelanchier*), one of the most important, widespread, and palatable of the western browse genera; mountain-ash (*Sorbus*); plums, cherries, and chokecherries (*Prunus* spp.); hawthorns (*Crataegus*), and the squaw-apple (*Pera-phyllum*) of the Great Basin region.

In view of its enormous importance as herbaceous forage it is remarkable to find that the bean, or legume, family (Fabaceae or Leguminosae), in a restricted sense, furnishes little or no browse on western ranges but, on the other hand, produces several toxic woody genera, such as locust (*Robinia*), mescalbean (*Sophora*), broom (*Cytisus*), and peabush (*Parosela*).

Closely allied to the pea family and in fact included in it, as subfamilies, by many botanists, especially the older ones, are three

families, the mimosa, or sensitiveplant (Mimosaceae), cassia, or senna (Caesalpinaceae), and ratany (Krameriaceae), all of which are of interest on the western range, the mimosa having great browse importance, in the Southwest particularly. To the mimosa family belong catclaw, or acacia (Acacia), silk flower, or false-mesquite (Calliandra), sensitiveplant (Mimosa), mesquite (Prosopis), and screwbean, or tornillo (Strombocarpa). The well-known Jerusalem-thorn (Parkinsonia) and paloverdes (Cercidium) of the South and Southwest belong to the cassia family, or subfamily.

The largest of all plant families, the composites (Compositae or Asteraceae) does not, aside from the large sagebrush genus (*Artemisia*), produce in the West any considerable number of palatable browse species, two or three woody groundsels (*Senecio*), about as many species of rabbit brush (*Chrysothamnus*), encelia, carphochaete, a woody viguiera, and possibly a few others being of value in certain localities. These composites are, in general, characteristic of the drier, lower, open and sunny ranges, and are of most importance for grazing in the plains, Great Basin, and southwestern regions or on winter ranges or at times when other feed is short. Some of these species, however, have such enormously wide distribution and abundance that the big percentage of the range vegetation occupied by them counteracts in large measure their more limited palatability per plant. Some of the sagebrushes seem to possess tonic properties—probably related chemically to the peculiar bitter taste of their herbage—that enhance their attractiveness to livestock, especially at certain seasons. The toxic qualities of this family (Compositae) are attracting attention increasingly because of the various cases of range poisoning that have been demonstrated to be due to certain shrubby genera, such as baccharis, rabbit brush, snakeweed (*Gutierrezia*), rayless goldenrod, or “jimmy-weed” (*Aplopappus*=*Isocoma*), *Tetradymia*, and woody aster (*Aster*=*Xylorrhiza*). Over 20 shrubby genera of composites are commonly represented on western ranges, in addition to at least three genera, bur-sage or bur-ragweed (*Franseria*), burrobrush (*Hymenoclea*), and *Oxytenia*—all more or less shrubby and rather or quite worthless as forage—belonging to the ragweed family (Asteraceae), subfamily, or tribe included in the composites by many authors. No shrubby members of the chicory-dandelion group (*Cichorieae* or *Cichoriaceae*), which produces numerous valuable herbaceous forage plants, occur in the United States, unless a few worthless, undershrubby skeletonplants (*Lygodesmia* spp.) be placed in this category.

One of the most valuable groups of western browse plants, especially in the plains and Great Basin regions and in soils more or less impregnated with alkali and saline matter, is the goosefoot family (Chenopodiaceae). Here are found such familiar shrubs as the saltbushes and shadscales (*Atriplex* spp.), winter fat or white sage (*Eurotia*), greasewood (*Sarcobatus*), and hop-sage (*Grayia*). The salty taste of the herbage of these plants seems to be very agreeable to stock.

The buckthorn family (Rhamnaceae) is of grazing interest almost solely because of one genus, but a very important one, *Ceanothus*.

In California one of the species, bluebrush (*C. integerrimus*), is practically without question the most important browse plant in the State.

The oak family (Fagaceae) is of western forage significance primarily because of the vast stretches of shrubby or low-arborescent oaks that form distinct types on numerous western ranges. While not of the highest palatability, perhaps on account of the large percentage of tannin, these low oaks because of sheer abundance become of great importance in the carrying capacity of not a few ranges.

The honeysuckle family (Caprifoliaceae) provides a large number of woody genera that are more or less grazed, perhaps the most important of which are the snowberries and coralberries (*Symphoricarpos* spp.) and the elders (*Sambucus* spp.). The former are of especial importance on sheep range, particularly in the Rocky Mountain and Great Basin regions; the elders are chiefly palatable in the fall, after frost.

The willow family (Salicaceae) contains two genera only, the willows (*Salix*) and poplars, cottonwoods, and aspens (*Populus*). This coterie of woody plants is especially characteristic of the moister soils and furnishes a great amount of palatable browse.

The heath family (Ericaceae) is a large and important group of shrubs and trees occurring on western ranges. It is confined, however, to acid soils and range interest is primarily in the genera that are poisonous to livestock. Here belong the azaleas, rhododendrons, menziesias, Labrador-teas, staggerbushes, and various other toxic genera popularly and promiscuously termed "laurels." Two genera, the manzanitas (*Arctostaphylos*) and the madrones, or true arbutuses (*Arbutus*) have a certain degree of forage value in some restricted localities. A related family (united to the heaths by the older botanists), the huckleberry (*Vacciniaceae*), seems to be quite innocuous, and a few huckleberries have a slight local forage importance.

Other plant groups that furnish shrubs of forage value on some western ranges include the jointfir family (Gnetaceae), to which the jointfirs, or Mormon-teas (*Ephedra*) belong; dragon-tree (*Draecena*) (which includes the yuccas and which many botanists prefer to merge in the Liliaceae or lily family) and the cacti (*Cactaceae*), of value as emergency stock feed in the arid Southwest; birch family (*Betulaceae*), the birches, hazels, and alders furnishing secondary browse on some ranges; buckwheat family (*Polygonaceae*), the flower clusters, dry fruits, and occasionally leaves and young stalks of some shrubby eriogonums being palatable to sheep; hydrangea family, including cliffbush (*Edwinia*) and the fendleras (especially of the Southwest), the latter genus (*Fendlera*) being cropped considerably on goat and cattle ranges; the gooseberry family (*Grossulariaceae*), currants and gooseberries being abundant, widely distributed, and not infrequently moderately palatable; the box family (*Buxaceae*) on account of the important southwestern shrub jojoba (*Simmondsia*); the cashew family (*Anacardiaceae*) because of the fair palatability of some sweet sumachs (*Schmaltzia*, or *Rhus* spp.); the maples (*Acer* spp.); the shrubby bushmints (*Hyptis*) and sages (*Salvia*) of the mint family (*Menthaceae*) occurring in California, the Great Basin, and the Southwest; and the figwort family

(Scrophulariaceae), a large group mainly of herbs but represented by the shrubby genus *Diplacus* and certain woody species of *Pentstemon* that locally produce a small amount of forage.

In the pages immediately following are presented fuller notes on what are perhaps the most important browse species occurring in the western range States, although no attempt is made within the compass of this one general publication to give a comprehensive treatment of individual species. These notes are presented in an order largely determined by circumstances. It would be difficult, if not impossible, to arrange the species satisfactorily in the order of their relative importance. On the other hand, an alphabetical sequence, while advantageous in a large reference work, is here objectionable, not only because of its artificiality but because it would prevent any indication of relationship between genera and would preclude convenient comment on secondary species of related genera. It has seemed desirable, therefore, to arrange the genera alphabetically within the families, the families being arranged in the Engler and Prantl sequence rendered familiar by the various modern botanical manuals and floras, and employed in most herbaria. The generic treatments begin with brief notes on the genus as a whole, followed by relatively full notes on what are considered the most important species; these are followed by briefer notes on secondary browse species of the genus.

The publication, while illustrated, is in no sense a botany, emphasis being placed wholly on the economic and ecological data; therefore botanical descriptions and keys are omitted in the treatment.

The Latin nomenclature is in accord with current usage in the Bureau of Plant Industry, United States Department of Agriculture. Effort has been made to have the common names conform to the list proposed by the American Joint Committee on Horticultural Nomenclature (3) or, if of arborescent species, to Sudworth's Check List (131). The majority of our native western browse species, however, do not appear in either of the works mentioned and in a very few cases it was felt that established western usage or other considerations justified a departure from these standards. Where one or more Latin or English plant names are used, the first one is regarded as the approved name, the succeeding ones being synonyms.

CONIFER, OR PINE FAMILY (CONIFERAE OR PINACEAE)

Western conifers (Coniferae) embrace about 14 genera and 80 species and are regarded by some botanists as an order (Pinales) consisting of four families, viz, the yew family (Taxaceae), pine-spruce-fir family (Pinaceae), baldcypress-sequoia family (Taxodiaceae), and cypress-juniper-cedar family (Cupressaceae, or Juniperaceae). The great majority of these species have silvical importance and many are of immense economic value as wood producers. Grazing on the young growth of such species is obviously to be discouraged. It does occur, however, to some extent even under proper use, and where the range is overgrazed it may take such proportions that satisfactory forest regeneration is interfered with (15, 28, 63, 113, 125).

The terpenes and other oleoresins of conifers are apt to have an irritant effect, and a considerable number of cases of scours and

abortion have been attributed to them. Numerous glucosides and other alkaloids, as well as volatile oils, have been isolated from various coniferous species, but the physiological action of most of such compounds is yet obscure. Pott (100) states that, in Europe, in the mountainous parts of the Tyrol, Steiermark, and Karnten, the foliage of silver fir (*Abies pectinata*), European larch (*Larix decidua*, syn. *L. europaea*), Norway spruce (*Picea abies*, syn. *P. excelsa*) and of various pines is fed extensively to both cattle and sheep either as a supplementary feed or as a conditioner. On the other hand, most of the livestock losses attributed to conifers have been in the Old World; in fact, under American conditions livestock losses due to conifers seem to be almost unknown.

Long (77) cites the case of three heifers which were poisoned by cropping Alaska cypress (*Chamaecyparis nootkatensis*) in England. After removal to another field, one died but the other two recovered. The same author quotes a case from the Journal of the (British) Board of Agriculture where four bullocks died apparently as a result of eating Monterey cypress (*Cupressus macrocarpa*), another west-American species cultivated in England and on the Continent as an ornamental. In this instance the fourth stomach of the animals was in an inflamed and irritated condition.

Seeds of piñons (*Pinus edulis* and *P. monophylla*) are eaten by stock, especially by goats. Cattle sometimes exhibit a liking for the foliage of Douglas fir (*Pseudotsuga taxifolia*, perhaps more accurately known as *P. mucronata*), and the writer knows of no case of serious poisoning attributed to it in the West. Long cites a case in England where two sheep nearly died, apparently as a result of nipping the bark from a branch of Douglas fir.

JUNIPERS (JUNIPERUS SPP.)

This genus is represented in the West by about 13 species. Goats and deer, especially in the woodland type of the Southwest, frequently exhibit a fondness for the berries and to some extent for the foliage of certain species, notably alligator juniper (*J. pachyphloea*), Utah juniper (*J. utahensis*) and one-seed juniper (*J. monosperma*). Pammel (95) quotes Schaffner and Halsted to the effect that the eastern red cedar, or Virginia juniper (*J. virginiana*) poisons goats that browse on it, and that its oil (oil of cedar) causes abortion. Apparently, however, no case of stock poisoning seems to have been reported in connection with the western analogues of red cedar, viz, Rocky mountain red cedar, or Colorado juniper (*J. scopulorum*) and western juniper (*J. occidentalis*). The common juniper (*J. communis*) is reported by Pammel as poisonous to goats. Long indicates that in parts of Europe juniper sprays are cut and fed to stock.

YEW (TAXUS SPP.)

Yews are the best known of the stock-poisoning members of the conifer family. Numerous horses, cattle, and other domestic animals, deer, rabbits, and other game, and even human beings, have died as a result of eating the foliage and fruit of the English yew (*T. baccata*) (77). The old shoots and leaves and the seeds are the most poisonous parts. Apparently the fleshy part of the fruit is

harmless. This is of interest to us because of the extremely close relationship, botanically, of our three native species of yew to the Old World *T. baccata*. In fact the Canada yew (*T. canadensis*) of the East has been involved in several cases of livestock poisoning; it contains the bitter alkaloid taxin ($C_{37}H_{52}NO_{10}$), a toxic heart depressant, and apparently other injurious substances as well. The Pacific yew (*T. brevifolia*), which ranges from Alaska to western Montana and California, is apparently not known to have poisoned livestock. It is, of course, not likely to be grazed except in winter or other time of scarcity of feed.

JOINTFIR FAMILY (GNETACEAE)

JOINTFIRS (EPHEDRA SPP.)

Five or six species of this genus commonly occur on semiarid western, or mainly southwestern ranges. All the species are known also as Mormon-tea, canatillo, Brigham tea, teamsters' tea, shrubby horsetail, and by other local names. The name jointfir is recommended for the genus *Ephedra* in Standardized Plant Names. American species are beginning to attract the attention of chemists as a possible source of the very valuable drug ephedrin (10, 103a).

Nevada jointfir (*Ephedra nevadensis*) (fig. 1, D) is a rather low, practically leafless, opposite-branched shrub, ranging from Utah to California, Sonora, and Chihuahua. It inhabits dry sagebrush or creosote bush plains and foothills, frequently in gravelly or rocky soils. Often abundant, but usually in scattered stands, it favors canyons, arroyos, and dry watercourses generally where the drainage is good and there is more or less subirrigation. The odd, greenish-yellow flowers (male and female borne on separate plants) usually appear in May and June.

The brushlike sprays of mainly bluish-green stems are often cropped by cattle, sheep, and goats on winter range, and the palatability of the species to cattle in winter has been placed by some investigators as high as 40 per cent. Owing to the immense number of the rushlike twigs produced and the relative abundance of the species on some areas the plant is at times a very important element in the winter-carrying capacity, and it is, in fact, cropped to a smaller extent the year round. This species (as well as others of the genus) has long been held in high local repute as a specific in acute urethritis, and has doubtless been employed as such by the Indians for centuries (129); strange to say, however, little definite scientific information exists as to its actual medicinal value. Schneider (118) states that the "Coahilla Indians prepare a cooling drink from the dried twigs and leaves. The seeds are sometimes roasted and eaten." Analyses are said to reveal a high percentage of tannin (146).

OTHER SPECIES

The largest of our American jointfirs is *Ephedra antisiphilitica* (107) which sometimes grows 9 or 10 feet high. *E. viridis* (fig. 1, A), conspicuous because of its bright yellowish-green color and very slender erect branches, is a rather important fall and winter cattle browse in some portions of the southern Great Basin region, and extends into Arizona and southeastern California. *E. torreyana*

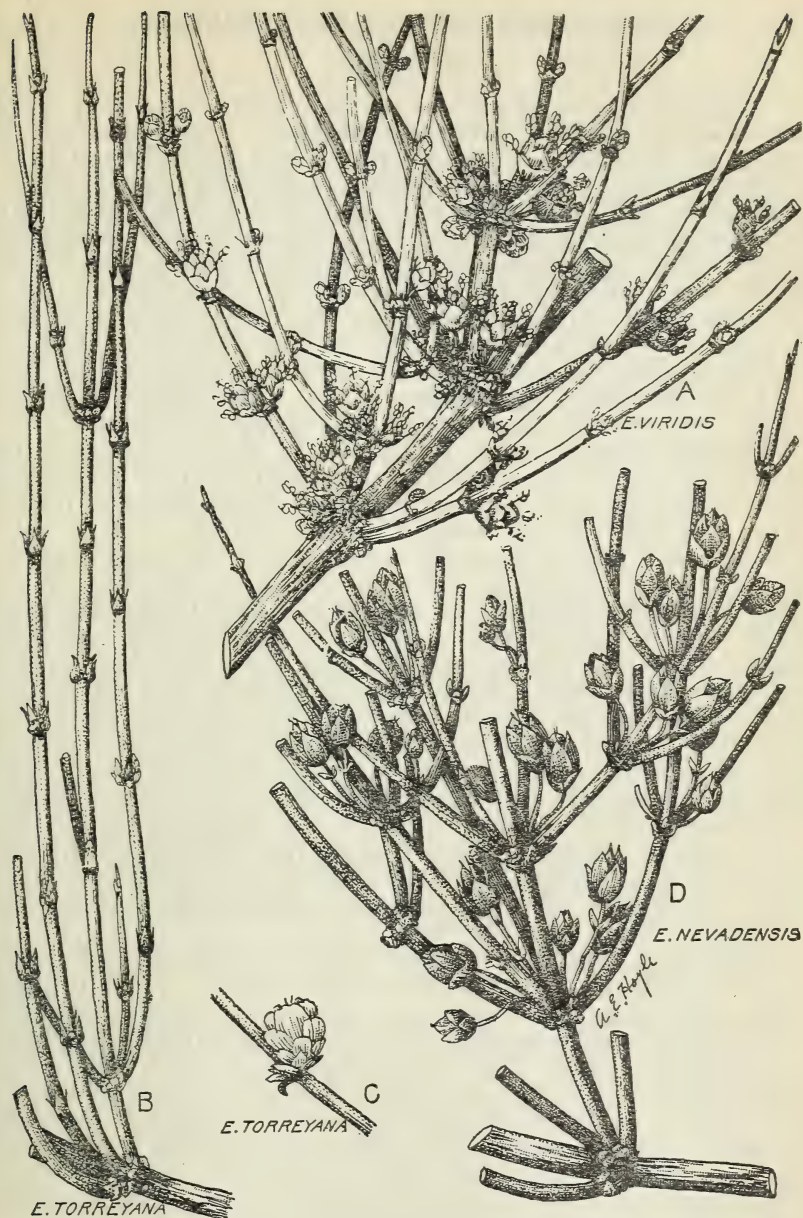


FIGURE 1.—Jointfir (*Ephedra*), a peculiar, virtually leafless genus of shrubs of southwestern and Great Basin deserts, whose green stems are cropped by livestock: A, Spray of *Ephedra viridis*, with staminate (male) inflorescence; B, spray of *E. torreyana*; C, twig and pistillate (female) flower of *E. torreyana*; D, pistillate (female or fertile) spray of *E. nevadensis*

(fig. 1, B, C) and *E. trifurca* both are grazed, particularly by cattle in winter; the latter, a rather small bush 2 feet high, is held by the Mexicans in high repute as a drug plant (75).

DRAGON-TREE FAMILY (DRACAENACEAE)⁴

YUCCA SPP.

At least 16 species of yucca occur on western ranges, of which approximately one-half have well-developed, treelike caudices or trunks; the remainder are shorter plants with tufts of basal leaves and no conspicuous stem save when the flower stalk is produced.

One of the chief difficulties with yuccas as forage is that they are fiber-producing plants and that these fibers are apt to cause digestive trouble unless cut or torn into short fragments so that they can be readily eliminated. Bloating, choking, and impaction are sometimes caused by soapweed feeding, but these can usually be avoided by proper preventive measures. Bloating rarely occurs except at the first feeding, the cattle soon becoming accustomed to the soapweed and developing a fondness for it. Choking and impaction seldom occur except from the use of hand-chopped material.

Soapweed (*Yucca elata*)⁵ (pl. 1, A), so named because of the saponaceous, emollient roots which are locally and to some extent commercially employed for soap, is typically a small tree, or treelike plant, with naked woody stems 4 to 6 feet high and 3 to 6 inches in thickness. Where, however, moisture and soil conditions are favorable it is sometimes 30 feet high, and with a somewhat stouter bole. Mexicans frequently call the species palmilla, and the roots, amole. The compound flower clusters appear in May and June. Soapweed occurs in a great variety of soils, but mainly on dry plains and mesas, from western Texas, through southern New Mexico and southern Arizona into Mexico. Forsling (41) has called attention to its frequent association with black grama (*Bouteloua eriopoda*) in sandy soil. On sand hills, where it often reaches its best development, it is frequently the most conspicuous plant in the landscape.

Soapweed makes but a slow growth, the stem putting on from 1 to 2 pounds yearly in weight; where the plants are utilized as emergency feed, a rotation of 10 or 15 years is necessary to establish a perpetual supply. Fortunately cutting does not kill them and they will sprout readily from the root.

Wholly aside from its undoubted utility in checking wind erosion and forming shade for other plants and shelter for range livestock in the arid regions it occupies, soapweed is of especial interest and significance here as an emergency feed for cattle and sheep in periods of prolonged drought. The juices of the plant are sweet and attractive to livestock and the coarse pulp, although deficient in protein, has fattening qualities. Special types of chopping and shredding machines have been devised for converting soapweed into suitable emergency feed (70, 41). The blooms and growing tip in the center of the upper leaf circle also form an important part of the forage for cattle in the late spring and early summer (41).

Small soapweed (*Yucca glauca*), known also as soapweed yucca, ranges eastward and northward from New Mexico as far as Missouri and South Dakota. The forage value of *Y. glauca*, except as silage

⁴ Many botanists prefer to merge this group in the Liliaceae or lily family.

⁵ The name "soapweed" is also in common use for *Yucca glauca* and for the southeastern *Y. angustifolia*. In horticulture these plants are known as yuccas, and the name soaptree yucca has been proposed for *Y. elata*.

or manufactured into emergency feed, is confined to the flowers and youngest leaves in dry seasons when other range feed is scarce. Lacking the pulpy stem of *Y. elata*, it is distinctly inferior to that species as feed.

RELATED GENERA

Plants of the related genera, sotol (*Dasyllirion*) and sacahuista or beargrass (*Nolina*), are also sometimes machine-cut or shredded, like soapweed, as emergency feed or silage, especially for cattle. Because of their small size, lack of trunk, and failure to sprout after cutting they are distinctly inferior to soapweed as emergency feed, though of approximately equal feeding value pound for pound. The leaves of *Nolina*, however, are often grazed closely during drought.

Texas sotol (*Dasyllirion texanum*), as found in western and southern Texas, is a species that can, according to Smith (124, p. 25) support sheep for four or five months in winter without access to water. A chemical analysis of the plant shows about 12 per cent of sugar and gum, 65 per cent of water, and 3 per cent of crude protein.

WILLOW FAMILY (SALICACEAE)

WILLOWS (SALIX SPP.)

At least 80 (perhaps considerably more) species of willow occur natively in the far Western States. The great majority of these have value as browse for livestock. Willows as browse are usually of most importance on cattle range, being common in moist meadows and along streams where this class of stock is wont to congregate. Willows form the most important summer browse of reindeer in Alaska (51, p. 25-26). Vigorous vegetative reproduction by root shoots and suckers enables most willows to contend successfully against severe grazing. Dwarf willows are common at alpine elevations in the high mountains.

Scouler willow (*Salix scouleriana*, syn. *S. nuttallii*) (pl. 1, C), known also as fire, Nuttall, mountain, and black willow, is one of the most common, abundant, and widely distributed willows in west North America, its range extending from British Columbia to California, New Mexico, and Saskatchewan; a variety occurs in Alaska.

Scouler willow is usually an erect shrub, sometimes a tree, but rarely as much as 50 feet high. Its best development is attained in such moist or moderately moist sites as the borders of mountain streams, meadows, and many north and west slopes. It is, however, broad in its moisture and soil tolerances and not infrequently occurs in coarse, dry soils and on warm southerly slopes, where the growth is more stunted and bushy and the leaves are generally smaller, more hairy, and darker green above. The altitudinal range is from about 2,000 feet in the north to nearly or quite 11,000 feet at the southerly limits. The species is never found at alpine and rarely at subalpine altitudes. On areas denuded by fire it forms a thicket of a transition type until the climax conifer cover is reestablished.

Because of its abundance, wide distribution, and accessibility, as well as its quick growth, recuperative powers, moderate size, and

relatively large and persistent foliage, Scouler willow is one of the best, if not the best, of the native western range willows for browse. Its broad soil requirements and rapid invasion of burns make it especially valuable, and it doubtless is often a useful nurse crop for conifer reproduction. Although it occasionally occurs in almost impenetrable thickets, its usual growth is in frequent, scattered, broad, and relatively low clumps—an ideal browse formation readily accessible to stock. Because of its form of growth and its common occurrence on the gravelly rocky slopes of high and medium elevation where sheep are wont to abound in late spring, summer, and fall, Scouler willow is one of the best of all *Salices* for sheep. In a very few places, it is true, Scouler willow is seldom if ever grazed, so far as is known, doubtless owing to peculiar local conditions; but in general its palatability to both sheep and cattle is high, both foliage and twigs being consumed. Sampson (110) regards Scouler willow as the most important species on burns in the Wallowa Mountains of northeastern Oregon and comments as follows on its grazing value there:

The time at which the leaves are developed renders it valuable as an early browsing plant. As high as sheep can reach, the branches are stripped of their leaves, though the bark is seldom eaten. * * * The more sheep browse on the willow the denser becomes the growth. This is due to the vigorous and persistent sprouting of new branches as a result of the trimming back of the young shoots through grazing. Even when a bush is cut to the ground a number of young shoots are produced.

OTHER SPECIES

One of the commonest and most widely distributed dwarf willows is Bebb or beak willow (*Salix bebbiana*), a rather large shrub or small tree which is generally held in high esteem whether on cattle, sheep, or goat range. Other common shrub-to-small-tree willows that are relished by livestock are narrowleaf willow (*S. exigua*); Geyer willow (*S. geyeriana*); blueback willow (*S. glaucops*), an important species of the highest summer ranges; and blue willow (*S. subcoerulea*). Five important essentially shrubby western willows are undergreen willow (*S. commutata*) of the Northwest (considered one of the most important sheep browses in portions of central Oregon and elsewhere); Idaho willow (*S. wolfei idahoensis*), a very good sheep browse in Idaho; Barclay willow (*S. barclayi*), especially esteemed for sheep; greensides willow (*S. monochroma*) of the Northwest (reaching southeast to Colorado), with thin, relatively broad leaves, dark green on both sides; and silverleaf willow (*S. argophylla*) of value for both cattle and sheep. Greensides willow is claimed by local observers to be the most palatable member of the genus in western Washington and most palatable in August and September. Among the dwarf high-alpine willows may be noted tufted willow (*S. caespitosa*) and summit willow (*S. saximontana*), sometimes called Rocky Mountain willow, too small to have much grazing significance but furnishing a few nibbles for sheep in summer, where other vegetation is none too abundant.

ASPEN, POPLARS, AND COTTONWOODS (*POPULUS* SPP.)

About 15 species and 8 subspecies or varieties of the genus *Populus* are native on western ranges. Of these trees, all of which furnish



F44589A F169750 F38664

A, Soapweed (*Yucca elata*), an emergency feed for cattle in the Southwest. The photograph, taken on the Jornada Range Reserve, N. Mex., shows the branched, arborescent form attained on the best sites; B, aspen (*Populus tremuloides* var. *aurea*), on the Uncompahgre National Forest, Colo.; C, Scouler willow (*Salix scouleriana*), a common and important western browse species. Photograph taken on the Wallowa National Forest, Oreg.



F157034 F19989A

A, Oak browse (largely *Quercus gambelii*) above Fish Creek, Montezuma National Forest, Colo., with understory of weeds and grasses. Such browse is an important element (though sometimes difficult to estimate) in the carrying capacity of such a range; B, composite brush type under mixed coniferous forest, Stanislaus National Forest, Calaveras County, Calif., 4,500 feet altitude. The most conspicuous shrub (with divaricate, thorny twigs) is whitethorn (*Ceanothus cordulatus*); between its patches and interwoven with it are extensive masses of the lower, darker, and less conspicuous bear mat (*Chamaebatia foliolosa*)

local browse on western ranges, the aspen is most important though others are nearly or quite as palatable.

Aspen (*Populus tremuloides*),⁶ often called quaking aspen (pl. 1, B), occurs from Labrador and Newfoundland to New Jersey, Pennsylvania, and, in the Appalachian Mountains, to eastern Tennessee, its westerly range extending to Kansas, New Mexico, and California and thence to Alaska; and east to Quebec; southward it ranges in the mountains into Lower California, Sonora, and Chihuahua, Mexico. Aspen grows in a great variety of soils and will endure a considerable degree of aridity; its best development is obtained in deep, moist, rich, but well-drained soils. Few trees will so successfully endure continued low temperatures, as its extended range beyond the Arctic Circle attests, and few tree species are more intolerant of shade. In the North it occurs from sea level up to 2,500 or occasionally as high as 3,500 feet. In the Rocky Mountains and Great Basin it ranges between about 6,000 and 10,500 feet. At the extreme southern limit of its range it is never found below 8,000 feet. Vegetative reproduction in this species is abundant and aggressive.

Because of its typically open stand and penchant for moist, deep, and fertile soils, the aspen type is often an indicator of naturally superior vegetative conditions and frequently supports an understory of weeds and browse that is esteemed highly by livestock. Moreover, the aspen itself when not too large and beyond their reach is very palatable to sheep and cattle, which browse extensively on the foliage and twigs, especially in the fall. E. R. Hall reports that aspen is the favorite food of the mule deer on the Kaibab National Forest.

The best utilization of the scrubrier aspen stands is normally for grazing, but where the species is desirable for its wood it is often necessary to adopt protective measures, especially with sheep. Aspen, when not valued locally more for its wood, is probably of especial value on sheep range, at least during the forepart of the season and at the higher elevations where the growth is scrubby. In the Northwest, however, it is regarded as somewhat more palatable to cattle than to sheep in the summer (July-August) and equally palatable in the fall (September-October). Sampson (111) has shown that cattle will browse aspen up to 60 or sometimes to 70 inches, and that the injury they cause aspen reproduction is usually but slight unless the lands are overgrazed or the animals inclined to congregate for extended periods where the aspen reproduction occurs. He notes that sheep are far more prone than cattle to eat the woody stems of aspen, but that sprouts averaging 45 inches high are practically exempt from destruction by sheep, so that three years of protection (estimating the average growth of sprouts to be 15 inches a year) is sufficient to place aspen sprouts beyond serious injury by sheep and four or five years of protection beyond injury by cattle.

⁶ Some authors regard the aspen of the Western States as a distinct species under the name *Populus aurea* Tidestrom, or as a variety (*P. tremuloides aurea* (Tidestr.) Daniels). In the Forest Service the same term applies to both types.

BIRCH FAMILY (BETULACEAE)

ALDERS (ALNUS SPP.)

About nine species of alder, mostly shrubs or small trees, occur on ranges of the West. Probably all are grazed to an appreciable extent, at least by cattle, which are much more apt to linger where alders grow than are sheep or goats.

The palatability of alders is not, in general, high; because of their abundance, however, especially in moist or wet meadows and along streams, they are sometimes an important secondary constituent of the forage crop. They propagate chiefly by underground rhizomes or suckers, often forming hardly penetrable thickets which, hindering ingress of stock and tending by competition to force the foliage upwards, decrease the browse value of this genus. The roots, like those of legumes, often bear nodules of nitrogen-fixing bacteria; it would seem likely that this symbiotic relationship would be reflected in a relatively high protein content of the herbage. With one or possibly two exceptions the small size of western species of alder precludes their use in the lumber trade and most of them appear to have more significance as watershed protection and forage than silviculturally.

Red alder (*Alnus rubra*, syn. *A. oregona*), or Oregon alder, is one of the most abundant and widely distributed species and in many localities its leaves and younger twigs are ranked as fair browse for cattle and sheep. Another of the commonest western alders is *A. sinuata*, with leaves thinner, more delicate, and more palatable than those of most of its congeners. This is held to be a fair sheep browse in the Wenatchee Mountains of Washington.

Mountain alder (*A. tenuifolia*), possibly better called thinleaf alder, is perhaps the commonest of the montane western alders and is one of the most palatable species of the genus for sheep. In central and northern Idaho and in many parts of the Northwest generally this is frequently considered a fair sheep browse.

In Alaska and the far North as a whole alders are often an important browse for moose, and Hadwen and Palmer (51) mention *A. alnobetula* as furnishing some feed in summer for reindeer.

BIRCHES (BETULA SPP.)

There are about 14 western birch species, nearly all of which usually occur as shrubs or small trees. A number of the shrubby western birches are taken fairly well by livestock, the juices of these plants appearing to be rather blander than those of alders, their foliage mostly more delicate, and the general palatability greater.

Red birch (*B. fontinalis*), often called water birch and mountain birch, a common western shrub, is an important browse species on many sheep and goat ranges, its palatability ranging from fair to very good.

Resin birch (*B. glandulosa*), often called mountain bog birch, one of the commonest and most widely distributed western birches, ordinarily does not exceed 6 or 7 feet in height. It occurs in the mountains up to subalpine or alpine elevations. Its palatability is generally considered to be good for both cattle and sheep but it is often inaccessible because of the boggy sites it inhabits. In north-

eastern California, however, the species has been found to be worthless for all classes of livestock. Coville (28) refers to the very close browsing of this species by sheep in meadows of the Cascade Mountains where, however, overgrazed conditions evidently obtained.

Ground birch (*B. rotundifolia*) is regarded by Hadwen and Palmer (51) as one of the six or seven most important summer-grazing plants for reindeer in Alaska, and of limited utility as winter feed.

Kenai birch (*B. kenaica*) also provides some summer forage for the reindeer.

HAZELS (CORYLUS SPP.)

Beaked hazel (*Corylus rostrata*) extends westward as far as some localities in North Dakota and Colorado, but probably has no range significance. The following species is the only other western hazel.

California hazel (*C. californica*, syn. *C. rostrata californica*) is ordinarily a bush 3 to 10 feet high, but occasionally appears to reach tree size. It occurs from British Columbia to California, between 1,500 and 3,000 feet in altitude in the north and 2,500 to 5,000 feet toward the south, and is found on moist wooded hillsides, along streams, in coves and canyons, and the like: It grows in a considerable variety of soils, from rather stiff clays to light gravelly or sandy loams. The flowers appear during February and March; the nuts ripen and drop off the bushes from late September to November.

California hazel is on some ranges extensively browsed by both cattle and sheep, while in other areas it is wholly neglected or scarcely touched. The species is so local in its distribution and limited in abundance that at best it can hardly be considered more than a secondary forage species. It is much esteemed locally for its sweet, edible nuts and would no doubt be worthy of cultivation on their account. The acidity of the involucre of the fruit has suggested its use as a vermifuge, as a substitute for the pod hairs of cowage (*Stizolobium pruriens*). The 2 and 3 year old shoots are highly prized by local Indians as warp material in basketry (65, pt. 2; 89).

OAK FAMILY (FAGACEAE)

Sierra chinquapin (*Castanopsis sempervirens*), known also as bush chinquapin, California chinquapin, goldleaf chinquapin, and chaparral, is a spreading shrub, 1 to 8 feet high, with smooth brownish bark and oblong leaves golden yellow beneath and 1½ to 3 inches long. The species is apparently confined to California, and chiefly to dry gravelly or rocky slopes and ridges of the Sierra Nevada. From the range viewpoint the species may usually be characterized as worthless, being seldom touched by livestock. It merits recognition here only because of its occasional local abundance and the possibility that concentrated feeding on chinquapin leaves may have an effect similar to that resulting from excessive oak browsing (p. 21). On July 18, 1913, Harriman Bros., sheep permittees on the Shasta National Forest, northern California, lost 50 sheep. The stomachs of these animals were found to be full of the pollen-covered leaves of this species. The nuts of Sierra chinquapin are sweet and edible.

Scrub tanoak (*Lithocarpus echinoides*, syns. *Quercus echinoides*, *Q. densiflora echinoides*, and *Pasania densiflora echinoides*), also known as dwarf tanbark and hedgehog oak, is a leathery-

leaved bush, 1 to 10 feet high, found on both dry ridges and moist slopes up to about 5,200 feet in California and Oregon. It is a small-leaved and entire-leaved shrub variety of tanoak or tanbark oak (*Lithocarpus densiflora*, syns. *Quercus densiflora*, and *Pasania densiflora*) and is avoided by livestock unless better feed is wanting, meriting mention here only because of local abundance.

OAKS (QUERCUS SPP.)

The oaks are a large group of woody, acorn-bearing plants almost exclusively confined to the Northern Hemisphere. About 75 species occur in the United States. In the eastern States the oaks are exceedingly important timber trees and have little or no economic significance as forage save for a few species and in restricted localities. In the West oaks are well represented but, with relatively few exceptions, have only slight or negligible importance in the lumber trade, the use of the wood being mainly restricted to cordwood, fence posts, mine props, etc. On the other hand, some of these oaks have greatest value as browse or in erosion prevention. The larger oaks of the Southwest and of the drier regions elsewhere are of great value as shade for range animals. Many species of oaks in this region are shrubs, often occurring as low bushes forming thickets or shineries of wide extent.

The most common classification of oaks is into two main groups: (1) White oaks, with pricklesmooth-edged leaves, annual acorns (maturing the first season), and characteristically light-colored bark; and (2) red (or black) oaks, usually with more persistent leaves whose veins frequently end beyond the margin in bristlelike or pricklike awns or teeth, biennial acorns (maturing the second year), and often dark-colored bark. Other popular oak groupings include live oaks, with thick evergreen leaves; chestnut oaks, with more or less chestnutlike leaves; and dwarf scrubby shineries oaks. As a matter of fact all these groups are somewhat artificial and tend to intergrade more or less. Probably the best classification of oaks is that of Trelease (1935), who recognizes six subgenera or sections, three of them occurring in North America, viz:

(1) *Leucobalanus*, or white oaks. Very large to moderate-sized or small trees or sometimes shrubby; bark gray, mostly rough; wood close, hard, and whitish, with numerous tyloses; leaves never aristate (awn-margined); stamens rather numerous (about 7-9), the anthers short and blunt; styles short and broad; fruit always annual (maturing first season), often long stalked, the scales mostly acuminate (tapered), often thickened and woolly, the acorn shell nearly glabrous not tomentose (woolly) within, the abortive ovules basal or subbasal.

(2) *Protobalanus*, or intermediate oaks. A small group of five species. Shrubs or small trees; bark gray-brown, scaly; wood close, hard, mostly brownish, with relatively few tyloses; leaves firm, entire or pungently toothed, mostly small; stamens numerous (8-10), the anthers pointed and rather long; styles short and broad; fruit biennial (maturing the second season), short stalked, the scales pointed, thickish and usually very woolly, the acorn shell tomentose (woolly) within, the abortive ovules lateral.

(3) *Erythrobalanus*, or red oaks. Trees or shrubs; bark dark, not scaly; wood moderately hard, often reddish, more porous and with fewer tyloses than the white oaks; leaves often incisely lobed, the lobes or vein tips usually produced into awns or bristles; stamens rather few (4 or 5), the anthers mucro-pointed; styles elongated and spatula-shaped; fruits usually biennial but in some species annual, mostly sessile (practically stalkless), the

scales mostly obtuse (blunt) but sometimes acute, seldom keeled, thickened or woolly, the acorn shell tomentose (woolly) and often 3-ridged within, the abortive ovules apical or subapical (except in *Q. emoryi*).

In this publication Professor Trelease's system is followed.

Mast furnished by oaks is an important feed item on many ranges, especially the acorns of the white-oak group, which are perhaps of greatest relative value on range for swine and for game such as bear. Chemical analyses made of the foliage of a number of species of western oaks indicate that the leaves evidently are not a balanced ration and should be supplemented by grass and other feed. Concentrated feeding on oak sometimes results in sickness and even death to cattle and young lambs (81, 84), because of the toxic astringency of the tannic acid present in the plant tissues. Losses and sickness are most apt to occur in spring, in exceptionally dry years and on overgrazed range. Prominent symptoms are constipation, emaciation, inertia, and the characteristic "shinneried" attitude. Such sickness and loss, however, are usually preventable by proper management. E. R. Hall reported in 1925 that in the course of studies of mule deer on the Kaibab National Forest oak was found to constitute a larger percentage of the deer's feed than did any other one plant. It was also found to be the most abundant of all the plants eaten by the deer on summer range in the zone of its occurrence.

White Oaks (Subgenus *Leucobalanus*)

Gambel oak (*Quercus gambelii*) (pl. 2, A) occurs from Wyoming to western Texas, Chihuahua, Sonora, Arizona, Utah, and probably parts of Nevada also; it is primarily a species of the Southwest and of the central and southern Great Basin. The species is an aggregate according to some modern authorities, who have segregated a number of species or forms, based largely on shape of acorn and shape, lobing, color, and persistence of leaves.

Gambel oak is typically a large shrub but is sometimes a small tree. In the Southwest especially it is a common understory of western yellow pine, being abundant on table-lands and hillsides between about 6,000 and 8,000 feet and occurring with greater or less frequency at least 1,000 feet below and above these limits. Gambel oak is important primarily because of its great abundance, especially on spring and fall range, its ready accessibility, and its huge total leaf surface. From its sheer quantity one is compelled to rank it among the foremost forage-producing plants of numerous areas within its range. It also is admirably resistant to heavy grazing. Associated with more palatable species Gambel oak is grazed lightly by cattle, sheep, and horses. The relatively sweet acorns, much relished by swine wherever they have access to the mast and eaten by other stock as well, have high fattening qualities. Chapline (15) regards the mast as of moderately high palatability to goats in summer. The young shoots of this oak contain from 4 to 10 per cent of tannic acid.

New Mexican oak (*Q. novomexicana*), **Vreeland oak** (*Q. vreelandii*), and **Utah oak** (*Q. utahensis*)—the latter known as Rocky Mountain white oak (131)—are perhaps hardly more than forms, varieties, or subspecies of Gambel oak. Chapline (15) reports New

Mexican oak, a small tree or shrub, as having value for goats in southern New Mexico, but its importance is derived more from abundance and distribution than from exceptional palatability. Utah oak, a large shrub or small tree, is ordinarily a fair browse on dry chaparral-covered hills and slopes, especially over limestone, between about 4,000 and 9,000 feet in Utah, southern Wyoming, Colorado, and northern Arizona and New Mexico. Excessive eating of the acorns, however, has caused losses from bloat among sheep in Utah. Vreeland oak, a small shrub not over 5 feet high, is abundant on dry slopes and loamy bench lands, chiefly of the yellow pine type, in southwestern Colorado and northern New Mexico, and provides considerable fair browse, especially in spring and fall, on certain ranges; its acorns are freely taken by all classes of stock in the fall.

Arizona white oak (*Q. arizonica*), or Arizona oak, a medium-sized tree, is (with the possible exception of gray oak, *Q. grisea*) the commonest live oak in southern New Mexico and Arizona and adjacent Mexico, being abundant in rocky foothills and canyons of the piñon-juniper belt up to subalpine elevations. Its palatability to goats, cattle, and sheep is fair and, because of its quantity and availability in late fall, winter, and early spring, it is locally one of the more important browse species.

Gray oak (*Q. grisea*), one of the commonest Southwestern live oaks, occurs both as a shrub and a tree in the region from Arizona to western Texas. The thickish, gray-green, or somewhat bluish leaves persist until the following spring. It is typical of the woodland type, or piñon-juniper belt, and is often the most abundant oak in its range, frequently growing in thick clumps. This member of the white oak group is in a number of places the most important local browse species. Analysis of the leaves and younger twigs, as made by the Bureau of Chemistry and Soils, is as follows:

	Per cent
Moisture	5.94
Ash	3.30
Ether extract	2.61
Protein	9.13
Crude fiber	27.11
Nitrogen-free extract	51.91
	<hr/>
	100.00

While high in crude fiber this species is fairly comparable to alfalfa hay both in nitrates (protein) and in carbohydrates (nitrogen-free extract), but rather low in fats (ether extract). It furnishes, therefore, a good body-building and energy-sustaining browse but with considerable roughage and rather inferior fattening qualities. The species is high in tannin content, and perhaps has potential utility for tanning.

California scrub oak (*Q. dumosa*), because of its abundance as chaparral on dry foothills and slopes and its typically low habit (rarely a small tree), is often a fairly important sheep and goat browse but is distinctly inferior on cattle range. Mackie's (79) analyses of the leaves of six native California oaks show that this species has a much higher amount of tannin than the other five, the percentage being 14.06 on an air-dry basis. Apparently, ewes

with young lambs should be handled carefully on ranges where this shrub is abundant in order to prevent any possibility of tannic-acid poisoning. This species is also of value in preventing erosion.

Shrub live oak (*Q. turbinella*, syn. *Q. dumosa turbinella*) is an evergreen bush ranging from Lower California to California, southern Nevada, southern Utah, and Sonora. It is often a rather valuable browse plant, being of greatest use during the winter season and at other times or places when more succulent feed is scarce. Its value is doubtless due chiefly to its abundance, its low and evergreen habit, and fairly bland properties. Although of more value for goats and sheep, it is considered on many ranges in central and southern Arizona the chief reserve supply of winter cattle feed.

Garry oak (*Q. garryana*), or Oregon white oak, also frequently known as California mountain white oak, is a Pacific tree or shrub, and appears to be the only oak in Washington State (99, 1). As this is probably the most important of the western timber oaks (130), it is perhaps somewhat unfortunate that, except in the chaparral form, it should be the most nutritious and palatable of the Pacific oaks. Mackie (79) states that Garry oak is a fattening feed and that its air-dried leaves are much the highest in protein (15.05 per cent, air-dry basis; 15.77 per cent, water-free basis) of any of the oaks analyzed, and its crude fiber content the lowest (16.26 per cent, air-dry; 17.04 per cent, water free). Coville (28) has called attention to the great fondness which sheep exhibit for the acorns of this species in the Mount Hood grazing district of Oregon.

Brewer oak (*Q. oerstediana*, syns. *Q. breweri* and *Q. garryana breweri*) of California, which is hardly more than a dwarf variety of Garry oak, forms pure scrub oak stands on rocky ridges and mountain slopes of the Sierra Nevada, Trinity, and Siskiyou Mountains and furnishes a large amount of fairly palatable sheep, goat, and cattle browse; its mast is almost equal to that of *Q. garryana*. However, its growth is sometimes too dense to enable satisfactory utilization.

SHINNERY OAKS

Havard oak (*Q. havardii*), prominent among the shinnery (or shin) oaks, covers large areas, mainly on sand hills in western Texas and eastern New Mexico, often occurring almost to the exclusion of any other shrub. This species has a prominent part in the history of western oak poisoning, as it is probably more often so involved than any other oak except *Q. gambelii* (84, p. 21-29). It is, however, of much importance as forage, and its relatively big and sweet acorns are relished by animals and are an asset in its favor.

Fendler oak (*Q. fendleri*), ranging on dry hills between about 5,000 and 7,000 feet from the Panhandle region of Texas to southern Colorado, northern New Mexico, and Arizona, and locally furnishing fair browse in quantity, is botanically close to Havard oak, but somewhat larger.

Wavyleaf oak (*Q. undulata*), sometimes called Rocky Mountain shin oak, is another important relative of Havard and Fendler oaks. It grows on dry, rocky mountain ridges and barren hills, between about 4,000 and 7,000 feet, often in thickets of vast extent and is not infrequently the chief vegetative feature of the landscape.

Wavyleaf oak ranges from western Texas to southern Colorado and Arizona and is usually a low straggling bush 3 to 10 feet high, but in mountain canyons of southeastern Arizona is occasionally a tree 30 feet high. Its leaves are persistent and it is usually regarded as a fair to fairly good cattle feed, especially in winter and spring. Because of its great abundance, it is sometimes one of the most important forage plants of its locality. Chapline reports it as good all-year goat feed, but especially good in spring.

Netleaf oak (*Q. reticulata*), often called Mexican white oak, is usually a sprawling shin oak 2 to 4 feet high in the United States, ranging from southwestern New Mexico and southeastern Arizona south into northern Mexico, where it becomes a large tree. It is local but common near summits of dry mountains, especially on south slopes and frequently in association with garrya, manzanita, and mountain-mahogany, and is a fair high summer range browse.

Sadler oak (*Q. sadleriana*), sometimes called Oregon chestnut oak and of interest as the only far-western chestnut-leaved oak, is usually a low shrub 2 to 4 feet high, but occasionally reaches a height of 8 feet, and forms dense thickets in white fir forests between about 4,000 and 9,000 feet in southwestern Oregon and northwestern California. It is of local importance as a watershed protector, is a poor to fair browse, and, as the local names "deer oak" and "bear oak" intimate, its sweet and edible acorns are much relished, not only by wild life, but by domestic livestock as well.

Intermediate Oaks (Subgenus *Protobalanus*)

This is a small group of five western species, of which probably only three have any particular range significance.

Canyon live oak (*Q. chrysolepis*), the oldest American oak, often called canyon oak, golden-cup oak, and maul oak, occurs in canyons and on ridges, between 1,500 and 7,000 feet, from southern Oregon to Lower California. Its wood is useful but, aside perhaps from its acorns, its browse value in general is low, though the evergreen habit—especially with the entire-leaved forms of the tree—make it a useful browse, especially for goats and cattle, on certain ranges where abundant and at times when better feed is scarce or absent.

Huckleberry oak (*Q. vaccinifolia*), regarded by some botanists as a subspecies or variety of canyon live oak, is a shrub 2 to 6 feet high, often forming extensive thickets between about 4,000 and 9,000 feet in northern California and southwestern Oregon. It is valuable as a protective covering on exposed slopes. Cattle and sheep eat the acorns readily, but the foliage is worthless or of low palatability.

Wilcox oak (*Q. wilcoxii*), ranging from New Mexico to southern Nevada and south into northern Mexico, is not much more than a southeastern variety of canyon live oak; it is one of the commonest shrubs or small trees of the foothills in the woodland type, and merits mention here only because of its abundance, its evergreen hollylike leaves not normally being acceptable to grazing animals.

Red (or Black) Oaks (Subgenus *Erythrobalanus*)

Red (or black) oaks are as a rule inferior as browse to white oaks, and their acorns are more bitter and less palatable, but two western

oaks of this group are of considerable forage importance, Emory oak and California black oak.

Emory oak (*Q. emoryi*), known locally as blackjack oak, ranges in the foothills and mountains between about 4,000 and 10,000 feet, from western Texas to Arizona and south into northern Mexico; it is the commonest forest oak in southern New Mexico and Arizona and, except when starved, is a tree. In many localities, when not too large, its evergreen leaves are taken fairly well by livestock, especially on winter range, and the edible acorns, unusually sweet for a "black" oak, are eagerly taken by domestic and wild animals.

California black oak (*Q. kelloggii*, syn. *Q. californica*), usually known locally as black oak and sometimes called California oak and Kellogg oak, is a common and conspicuous species in inland California and parts of Oregon. It usually grows in a mixed conifer type with yellow pine, incense cedar, sugar pine, and white and Douglas firs. Although the species is of tree form, the wood has practically no value as lumber (130) and little commercial use aside from fuel, posts, and tool handles. It is, when at all within the reach of grazing animals, a rather important browse plant, especially for cattle, though sheep and goats also take it fairly well, often pulling down the overhead branches and cropping the leaves. Mackie (79) has found the leaves of this species the highest of all the oaks analyzed by him in ether extract and nitrogen-free extract (7.06 and 40.50 per cent, respectively, for air-dry material), apparently indicating a fattening and energy-producing food. Although the waxes and resins included in the ether extract are distasteful to grazing animals and decrease the species' forage value, it is a matter of common observation that livestock tend to fatten on the leaves of this oak.

ELM FAMILY (ULMACEAE)

HACKBERRIES (CELTIS SPP.)

Douglas hackberry (*C. douglasii*) is the only one of the three species of hackberry (fig. 2) occurring natively on western ranges that appears to have any material range significance. This species, a scraggly shrub or small tree, is found in both moist and dry soils, along or near streams, rocky ravines, or arid cliffs, from Utah and Idaho to Oregon, Washington, and British Columbia. It is an important secondary browse constituent of the forage crop on many of the lower areas of the northwestern forests, providing considerable browse for cattle and sheep, especially on winter and early spring range. The leaves of this hackberry are frequently galled by an insect (*Pachypsylla* sp.), which, of course, greatly reduces its palatability. A. R. Standing reports that this condition is general along the west base of the Wasatch Mountains.

Paloblanco (*C. reticulata*) and **spiny hackberry** (*C. pallida*), sometimes called, respectively, netvein hackberry and thorny bill, while often common in the Southwest are browsed only under overgrazed conditions. Their sweetish-pulped berries, like those of other hackberries, are eaten by certain birds, reptiles, and other wild life.

FIGURE 2.—Western hackberries (*Celtis* spp.)

MISTLETOE FAMILY (LORANTHACEAE)

A number of the common mistletoes (*Phoradendron* spp.) are palatable to cattle and when in reach are readily eaten. In times of food scarcity they are sometimes knocked off their host trees (conifers, oaks, buckeyes, mesquite, etc.) with poles and thus assume some local, though temporary, importance as emergency rations. The family is, of course, far more significant silviculturally than on the range.

American mistletoe (*P. flavescens*), the State flower of Oklahoma, has commercial value for Christmas decorations and medicinal properties (78).

BUCKWHEAT FAMILY (POLYGONACEAE)

ERIOGONUMS (ERIOGONUM SPP.)

Several species of the huge, essentially western, and mostly herbaceous genus *Eriogonum* are low shrubs, and the flower and fruiting heads of these are relished more or less by goats and sheep.

Slender buckwheatbrush (*E. microthecum*), known in the Toyabe Mountains of Nevada as sheep sage, is a low shrubby perennial, usually 6 to 12 inches but sometimes as much as 24 inches high, found on dry plains, prairies, table-lands and mesas, and up to middle elevations in the mountains. It is one of the most widely distributed species of the genus, occurring from western Nebraska to Colorado, Arizona, California, Washington, and Montana. The rather small, compounded cymes of usually pinkish flowers appear from June to October, the buckwheatlike fruits maturing and disseminating from September to November. Although the forage value of this plant varies with its associates and local abundance, in general goats, sheep, and cattle exhibit a fondness for the flowers, fruits, and tops, and Griffiths (48, p. 56) ranks it as "of much importance in the higher foothills and lower mountains" of Arizona.

Wright buckwheatbrush (*E. wrightii*) of the arid plains and foothills of southwestern United States is regarded in parts of Arizona and locally elsewhere as a feed fairly good for goats and sheep and fair for cattle.

GOOSEFOOT FAMILY (CHENOPODIACEAE)

SALTBUSHES (ATRIPLEX SPP.)

The saltbush genus is a large group, of world-wide distribution, embracing about 150 species. Of these approximately 60 occur in the United States, mainly in the West. The Great Basin with 32 species (134), and California with 28 species (65, pt. 4), form the center of distribution, but the genus is also well developed in Colorado, Arizona, New Mexico, Wyoming, and western Texas. Many of these species are herbaceous and probably all are salt tolerant. A few species, such as garden orach (*A. hortensis*) and *A. hastata*, are occasionally grown as potherbs. The salty taste of the herbage of many of these plants evidently enhances their palatability to livestock, at least at certain times, but this property is also likely to impart a bad flavor to milk and might possibly have a bad effect where unweaned calves, lambs, and kids are pastured. An admixture of grasses or other feed is doubtless desirable on saltbush range.

It is generally admitted that the genus *Atriplex* is one of the most important native forage groups in the great interior mesa of Australia which forms the chief sheep-grazing region of the continent. Jared G. Smith (124) quotes Baron Von Mueller, Australian botanist, to the effect that many of the valuable qualities of Australian wools are due to the abundance of this and other

saltbushes in the regions in which the sheep are grazed, and he cites other authority to the effect that if the saltbushes were entirely exterminated the value of the wool would tend to decrease.

Fourwing saltbush (*Atriplex canescens*) (fig. 3) is a freely branching shrub, occasionally 6 to 10 feet high but usually lower, with grayish-white stems and leaves and rigid twigs. It is one of the most widely distributed west-American species of its genus, being fairly common to common from South Dakota to western Texas, California, Nevada, Utah, and Wyoming.

This species has in the past been fairly generally known by the name "shadscale." Historically, however, shadscale pertains to *A. confertifolia* (p. 30) and the name is also picturesquely descriptive of the flattened, concentrically ringed fruits of that species and not at all appropriate to the winged fruits of *A. canescens*. Other names in more or less common use are chamiza (New Mexico), cenizo (78), buckwheat shrub, bushy atriplex, salt sage, wafer sage (brush), and (white) greasewood.

Fourwing saltbush is characteristic of dry, moderately saline or alkaline situations in the plains and foothill regions and not infrequently is the dominant species over extensive areas. It will grow on lands heavily impregnated with white alkali and also withstands small amounts of black alkali.

Numerous chemical analyses and seeding and feeding tests have been conducted with fourwing saltbush, and a myriad of notations have been published or written relating to its forage value. It is unquestionably one of the more important arid-site shrubs, especially in the Southwest and Great Basin regions. Its importance is due to its abundance, accessibility, size, agreeable saline taste, evergreen habit, high percentage of usability—leaves, stems, flowers, and fruits all being edible—and tremendous root development enabling great tolerance of drought, ability to withstand low temperature, copious production of fattening, highly palatable seed, and high nutritiousness. Roots of this species have been known to reach 19½ feet below ground level (42). The disadvantages of *Atriplex canescens* as a forage plant are in large measure due to its brittleness and the palatability of its seed. The seed crop, when produced, is devoured wholesale. Elsewhere the bushes are so broken down and weakened by grazing that they either fail to produce a viable seed crop or else succumb entirely. If protected in summer, however, the shrub can successfully withstand reasonably heavy winter use.

Jared G. Smith (124) considers the species worthy of cultivation on soils that will not grow grain, alfalfa, or tame grasses and regards it as superior to the shrubby Australian saltbushes, in that it thrives where the winters are quite severe.

In its annual report for the year ended June 30, 1919, the New Mexico Agricultural Experiment Station published chemical analyses of this species (under the name "chamiza") showing, on a moisture-free basis, the following percentages of crude protein:

	Per cent
Leaves.....	18.94
Old leaves and stems.....	10.55
New leaves and stems.....	10.66
Fruits.....	10.03



FIGURE 3.—Fourwing saltbush (*Atriplex canescens*), locally known as chamiza, one of the most widely distributed and valuable shrubs of its genus

The percentage of crude fiber was only slightly more than for alfalfa hay, and that of carbohydrates somewhat greater. The protein content is, as indicated, remarkably high. The high nutritive value of the herbage is beyond doubt.

Bidwell and Wooton (9), analyzing specimens collected in midwinter, find a remarkably high average protein (16.4 per cent) and nitrogen-free extract (41.2 per cent) content after numerous alternate freezings and thawings.

The Forest Service has thus far received no complaints of injury to livestock under range conditions from eating fourwing saltbush. There is, however, evidence that too concentrated feeding on this shrub might cause scours in range cattle (42), and that it does occasionally poison sheep (42), and Miller of the Nevada Agricultural Experiment Station reports (33) that he has separated out a saponin-like substance from this species which causes a sort of anemia (*haemolytic properties*), the action however being largely seasonal. It would be of interest to know whether the symptoms of sheep poisoned by an overdose of fourwing saltbush herbage are analogous to those resulting from an overdose of common salt (sodium chloride). The high degree of alkalinity in the herbage of the saltbushes suggests the desirability of an admixture of grasses or other feed in utilizing these species.

The New Mexico Agricultural Experiment Station has been making intensive studies of fourwing saltbush, and Wilson (142, p. 28) has found that, under range conditions existent in southern New Mexico at least, "the presence of calcium carbonate in pulverized form at or near the surface of the soil appears to be very beneficial, if not quite necessary" for the growth of young seedlings of this species.

Australian saltbush (*A. semibaccata*) is one of the forage saltbushes which have been experimentally cultivated in the West. Success in cultivating Australian saltbushes has, on the whole, been rather indifferent. The Australian species do not, at least as a rule, withstand the low temperatures that most of our native montane species must endure. *A. semibaccata* has, however, thriven in warm and dry districts of California where, according to E. Nelson (94), all classes of stock not only eat it readily, either green or cured, but are said to thrive on it. It is cut for hay, as well as used for pasturage, and may be mowed as many as three times in a season. Yields of 20 tons of green feed or 5 tons of hay per acre are not at all unusual.

Shadscale (*A. confertifolia*), or spiny saltbush (frequently known locally with other species of *Atriplex* as salt sage, is one of the most important native species of this genus. It ranges from southern Idaho to Wyoming, Utah, New Mexico, northern Mexico, eastern California, and southeastern Oregon. Male and female flowers are borne on separate bushes, which average 1½ to 3 feet in height but are occasionally as much as 5 feet tall, growing typically in dense clumps about 4 to 8 feet in diameter; the branches are spiny tipped. The species is common in alkaline valleys, but is sometimes found in gumbo soils, around the borders of dried-up alkaline lakes, and on dry plains and hills up to about 6,000 feet. Shadscale is a very valuable constituent of the winter and desert ranges which it occupies. Jared G. Smith (124) has the following interesting note on the species:

The leaves and fruits drop off in autumn and are collected in the depressions of the surface or form little wind drifts behind the bushes. These piles of

leaves and seeds are the first to be eaten by the sheep and cattle when they enter the winter pastures. The spiny branches are also browsed to the ground. This salt sage is apparently more resistant to strong alkali than almost any of the others, as it often occurs on "greasewood lands" containing a large amount of sal soda.

Professor Jepson (65, pt. 4) alludes to the resistant properties of shadscale to overgrazing in the following paragraph:

After losing their fruits the branches of the short panicle become rigid and spinescent. Such naked spiny branches persist for several years and provide considerable protection for the bush against the attacks of grazing animals. All the shrubby species exhibit similar characteristics in greater or less degree, but in none other of our species is the spininess so effectively developed as in *A. confertifolia*.

Big saltbush (*A. lentiformis*), sometimes called quailbrush, is perhaps the largest of our native saltbushes, often reaching a height of 8, 10, or even 12 feet, and about half as much in breadth. It is a typical desert plant ranging from California, through southern Nevada and Utah, to Arizona and northern Mexico. It is grazed by livestock principally from December to July, when other feed is short, particularly at times of spring drought when the normal crop of succulent annuals fails. At such periods the species is sometimes subjected to heavy browsing. The large size, diffuse form, large ovate leaves, lack or but mild development of spinescent branches, and abundance—especially on river benches where cattle are wont to congregate—make this species one of considerable value. Although brittle and subject to rather severe injury from close grazing it is usually not exposed to yearlong cropping and is able normally, with proper management, to recuperate during the intervals of nonuse.

Nuttall saltbush (*A. nuttallii*) is a low leafy shrub, seldom over 3 feet high and usually not over half that height, occurring in bad lands, alkaline plains, and other dry sites from Saskatchewan to Colorado and Nevada, at elevations of 4,000 to 7,500 feet. Few plants are more alkali-tolerant than this species. Sheep are very fond of it, especially in fall, winter, and spring, and the seedlike fruits are reputed to be notably fattening. Although it is deep rooted and withstands grazing satisfactorily, too heavy use is liable to exterminate it, for the bushes are small and rather easily broken and all but the heavier stems and branches are edible. It is reported as providing the greater part of the all-winter forage in the Red Desert of Wyoming (92), and in that State (94) is ranked as the most important native saltbush and described as a rather aggressive species.

WINTER FATS (EUROTIA SPP.)

Winter fat (*Eurotia lanata*), commonly called also white sage, winter sage, feather sage, and American eurotia, is a bushy-branched shrub, 1 to 3 feet high (fig. 4), ranging from Saskatchewan and Manitoba to western Nebraska, Colorado, western Texas, California, and Washington. The herbage, at least during the main growing season, is densely beset with rather long, matted, branched hairs, whitish at first and later rusty. The species is essentially one of the lower plains and valleys, growing in dry soils that are often moderately impregnated with white alkali or saline material. In



FIGURE 4.—Winter fat (*Eurotia lanata*), a valuable winter feed for sheep and cattle

such sites it is frequently abundant and widespread, sometimes becoming the dominant feature of the landscape. Frequent associates of winter fat are greasewood (*Sarcobatus vermiculatus*) and salt-bushes; in the higher parts of its range it often grows with wheat-grasses and blue grama; in the Southwest it is a frequent component of the mesquite type. It will not tolerate as much alkali or salinity as its relative, greasewood. Winter fat occurs in the Wasatch Mountains at least as high as 10,000 feet on north, and sometimes west, slopes but grows in only sparse stands at such altitudes, inhabiting dry sandy or shallow clay loams, open grass-weed parks, and the like.

All classes of livestock relish this plant, but it is particularly important on sheep and cattle range. As its name implies it is a conspicuously fattening feed and is of chief value on winter (or fall) range where, under the overgrazed conditions not infrequently obtaining on such areas, it is sometimes exterminated by the livestock. The species undoubtedly has been more abundant and once covered a wider area in the West than it does now. Fortunately it responds

admirably to regulated grazing. It is a prolific seeder, and is easily grown under cultivation, especially if the seed is covered by raking

or harrowing. These abundant fruits, or seeds, despite their overcoat of cotton-hairy fuzz, are much relished by grazing animals and are evidently nutritious and fattening, adding greatly to the range value of the species. Jared G. Smith (124) states that "stock grazed on lands where winter fat grows thrive well and are said to be remarkably free from disease because of the tonic properties of this plant." Another valuable characteristic of winter fat is its rapidity of growth, considering that it is a species of arid habitat (xerophyte), the herbaceous stems often attaining a length of 1 or 2 feet during the growing period. These slender season's twigs and the small, narrow leaves are both consumed by the animals. Bidwell and Wootton (9) mention this bush as a valuable goat feed, and Cotton (22) refers to its value for horses in the "John Day Beds" of Yakima and Douglas Counties, Wash. It is also one of the more important winter-browse species for elk in the Jackson Hole country.

A number of analyses of winter fat have been published (74, p. 42; 9, p. 24), all showing remarkably high percentages of crude protein.

HOP-SAGES (GRAYIA SPP.)

Spiny hop-sage (*Grayia spinosa*, syn. *G. polygaloides*) is a small, bushy shrub, 1 to 3 feet high, variously known also as grayia, Gray's saltbush, spiny sage, horsebrush, and saltbrush. It has somewhat mealy herbage, small but rather succulent leaves, and slender, pale twigs that are sharp and spinelike at the tip. The species is distributed from Washington to California, Utah, Wyoming, and Montana.

Although spiny hop-sage often grows where there is considerable moisture, it is more essentially a desert plant. It is common in alkaline situations, especially in the sagebrush (*Artemisia tridentata*) type from about 2,500 feet elevation in the Northwest up to about 7,000 feet in Utah and Nevada. Frequently in association with various species of *Chrysothamnus* it is found in a great diversity of soils, such as limestones, valley lands, baked alkali, coarse gravel, dry heavy clays, and scabby areas.

Where this bush occurs in any quantity it is an accession to the forage cover. It is eaten in fall, winter, and spring by all classes of livestock and is considered good for both sheep and cattle, which crop the buds and leafy twigs with avidity and fatten notably on the copious harvest of flat, winged fruits. The female (pistillate) plants thus are most desirable as forage. Sheepmen regard the leaves as a "strong" feed, producing a solid fat. Nelson (92) lists it among the choice species of the Red Desert region in Wyoming, and notes that the leaves and enormous quantities of seeds fall early and are collected by the wind into little drifts or piles under the bushes and in the hollows of the ground. When sheep are fed over such ground these piles are the first to disappear. The leaves on the season's twigs tend to be larger than those on the old growth, and it is quite possible that the pruning of proper grazing is beneficial and improves the forage.

Spineless hop-sage (*G. brandegei*), a small, nonspiny congener with longer and narrower leaves and much smaller fruits, occurs in western Colorado and eastern Utah and is reputed to be one of the

most valuable winter forage plants on the low, dry areas where it grows.

GREASEWOODS (*SARCObATUS* spp.)

Sarcobatus is a genus of two west-American species, *S. vermiculatus* and the smaller, spinier, darker-barked, more downy, larger-fruited *S. baileyi*, syn. *S. vermiculatus baileyi*, of the Colorado and Mohave Deserts.

Greasewood (*Sarcobatus vermiculatus*) (fig. 5), sometimes called "black greasewood," also "chico" by Spanish-speaking people, is a shrub 2 to 10 feet high with a bark that in the young plants is whitish, but in the older plants is grayish sometimes verging on black. It has rigid, intricate branches, many of the twigs becoming thornlike, or spinelike at the tip, and small linear fleshy leaves. A general oleaginous appearance is reflected in the vernacular name.

This shrub is found in every State west of the one-hundredth meridian and in southwestern Canada as well. It is characteristic of semiarid or arid alkaline plains at elevations of 5,000 to 8,000 feet in the South and 2,000 to 4,000 feet in the North, and is often exceedingly abundant. The species is especially characteristic of black alkali⁷ sites—so much so that places where it occurs are deemed impossible of reclamation for agricultural purposes. The physical properties of the soils it inhabits exhibit the greatest variation, from the heaviest adobe to light sandy soils. It is, with the exception of burroweed, often called pickleweed (*Allenrolfea*), probably the most alkali-resistant of native American shrubs (20, p. 233-236; pl. 53). Saltbushes and saltgrass (*Distichlis spicata*) are frequent associates of greasewood.

Jared G. Smith (124) calls attention to the fact that greasewood, because of its deep and broad root system, absorbs large quantities of soda salts, much of which finds its way into the leaves during the natural processes of growth. As the leaves fall, there is an accumulation or concentration of soda in the surface soil. Ash analyses of the plant at the New Mexico Agricultural Experiment Station showed 22 per cent of potash and 23.9 per cent of soda.

Greasewood is an important range browse; in fact it prevents many saline areas of vast extent from being almost worthless. In some places it is one of the most valuable winter sheep and cattle feeds, although hardly the equal of winter fat or perhaps of big sagebrush (*Artemisia tridentata*) in this respect. Horses and goats also crop it. The leaves, younger stems, and especially the seeds are consumed, the natural saline taste doubtless enhancing the palatability. As these parts are all produced in great profusion, and the form, stature, and open stand are conducive to full utilization, the species is a heavy forage producer. In fact, its normal height of 3 to 5 feet on the range is probably due to grazing; in wholly protected areas the average height is often several feet greater. Because of the high alkaline content of the herbage, livestock undoubtedly do better on a greasewood range when given supplemental feeding, fresh water in quantity, or both. Moreover, if greasewood is eaten in too great concentration, definite symptoms of poisoning may result. Couch

⁷ Black alkali is the result of the reaction of sodium carbonate (sal soda, or washing soda, $\text{Na}_2\text{CO}_3\cdot\text{H}_2\text{O}$) and soil humus, and is extremely deleterious to nearly all plant life.

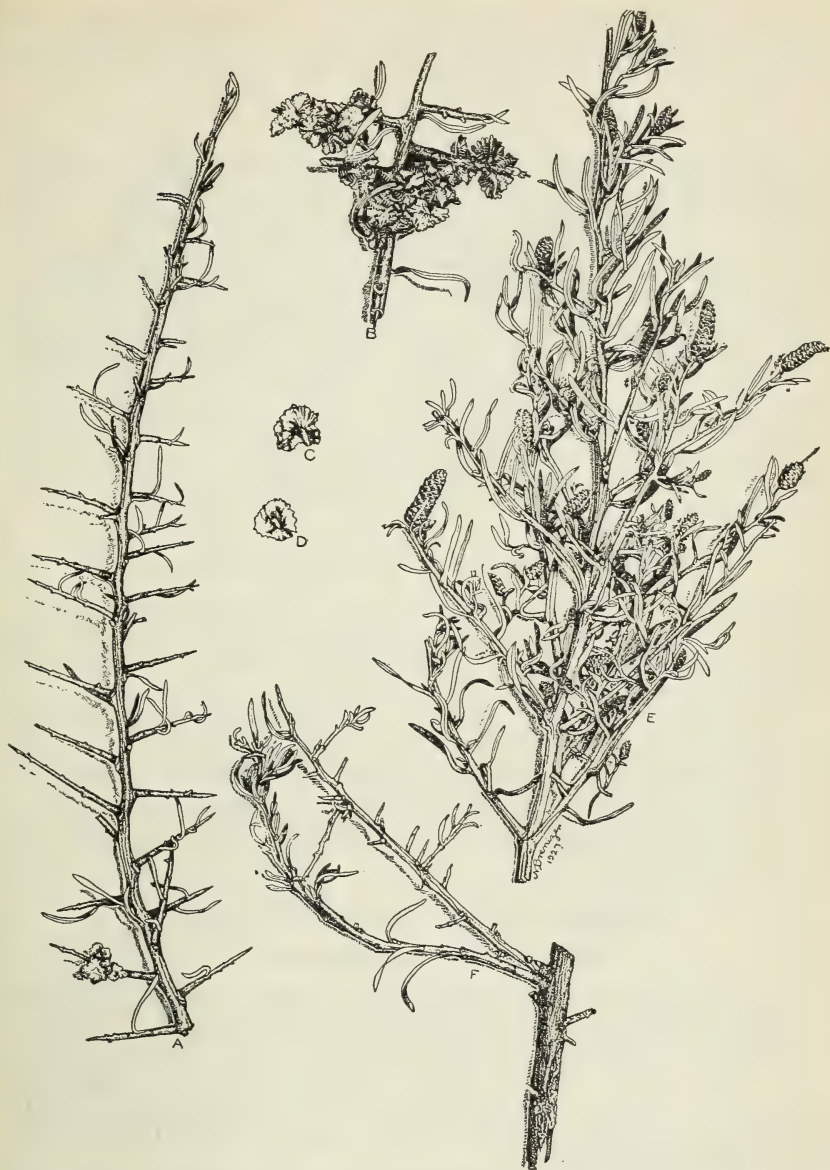


FIGURE 5.—Greasewood (*Sarcobatus vermiculatus*), an abundant, very alkali-resistant western shrub: A and B, Pistillate (female or fruiting) spray showing thorny twigs; C and D, individual fruits; E, staminate (male) spray; F, sterile spray showing bark on older stems

(23) states that this is due to the large proportion of oxalic acid and unusually large quantities of sodium and potassium salts (oxalates) which the edible portions of greasewood contain. Marsh, Clawson, and Couch (83) report that poisoning occurs only when at least 1.5 pounds to the hundredweight of animal is eaten in a very short time

and that the affected animals usually die. It is a rather common observation among stockmen that if eaten profusely, when in vigorous growth, greasewood will sometimes cause bloating.

OTHER GENERA

Several undershrubby species of seepweed, often called sea blite (*Dondia* spp.) and of molly (*Kochia* spp.), notably green molly (*K. americana*), furnish a fairly copious supply of small leaves and slender twigs of moderate palatability in dry, saline areas of the West, especially the Great Basin region, and in some places are fairly important winter sheep feed (9). Burroweed, or pickleweed (*Allenrolfea occidentalis*), known also as iodine-weed and frequently, but erroneously, as samphire, is a fleshy, jointed, and practically leafless undershrub of the Great Basin and Southwest which Shantz (in Clements, 20) has stated will endure a soil alkali content of 1.2 per cent. It is thus the last vegetation to succumb to salinity except the glassworts (*Salicornia* spp.). Except under starvation conditions burros alone among domestic animals appear to be able to stomach *Allenrolfea*.

BUTTERCUP FAMILY (RANUNCULACEAE)

In the West this family appears to be composed exclusively of herbs, save only for the woody *Clematis* vines and perhaps the botanically anomalous Southwestern shrubby genus *Crossosoma*, the latter being apparently worthless as forage.

The numerous species of *clematis* (*Clematis*, including *Atragene* and *Viorna* of some authors), are nearly negligible as forage. Columbia *clematis* (*C. columbiana*, syns. *Atragene columbiana*, *A. occidentalis* (of Rydberg, not Hornemann), and *C. verticillaris columbiana*), of the Northwest and northern Rockies, is reported from northwestern Montana to be eaten when the leaves are young and tender.

BARBERRY FAMILY (BERBERIDACEAE)

HOLLYGRAPES (ODOSTEMON SPP.)

Hollygrape is commonly known by a number of other names, such as Oregon grape, hollyleaf barberry, mahonia, and palo amarillo. The species are merged by many botanists in the barberry genus (*Berberis*), but the nonspiny stems; evergreen, pinnately compound leaves with prickly leaflets; terminal inflorescence; and mostly spherical, mainly blue berries, give the group an entirely different aspect from true barberries.

The very acid berries of hollygrapes are valued for jelly and preserves or, in a few species, are edible raw. Bark, roots, and berries of some species are used medicinally. The yellowish wood is sometimes used as a dye. These shrubs often have erosion-control value on dry slopes, and some are cultivated as ornamentals, because of the foliage, sweet-scented yellow flowers, and bright-colored fruits. These plants are normally unpalatable to livestock but merit notice here because of their commonness and wide distribution on western ranges, and because of their actual or potential economic significance.

Creeping hollygrape (*Odostemon repens*), the commonest of our west-American species, is a low trailing species ranging from southeastern British Columbia to northeastern California, New Mexico, and the Black Hills region of the Dakotas. In 1919 a loss of cattle on a driveway of the Tonto National Forest, Ariz., was attributed by the stockmen to this species. C. D. Marsh, of the Bureau of Animal Industry, United States Department of Agriculture, called attention to the fact that, although the plant is not very poisonous, certain toxic alkaloids have been found in hollygrapes.

Oregon hollygrape (*O. aquifolium*) (pl. 3, A), usually known simply as Oregon grape, has a distinct northwestern range, from British Columbia to Oregon. It is a tall erect shrub, 3 to 6 feet or occasionally even 10 feet high, and is the State flower of Oregon. Oregon hollygrape has no forage utility, but is a valued ornamental and the root bark is in the drug trade.

Red hollygrape (*O. haematocarpus*) and **Frémont hollygrape** (*O. fremontii*) are two large shrubs of the Southwest characteristic of brush types in the piñon-juniper belt. *Haematocarpus* occurs also at lower elevations in the catclaw belt. This species is one of several known by Mexicans variously as algerita, agarita, agrillo, and agrito(s). It has juicy, blood-red berries, whereas *fremontii* has dry, inflated, dark-blue berries. Neither species is ordinarily regarded as forage, but national-forest officers report that cattle and horses crop the leaves and tender shoots of red hollygrape in the Tonto Creek country, presumably, however, in the winter season or when other feed is scarce. Red hollygrape berries are highly prized for domestic jellies and preserves.

SWEETSHRUB, OR CALYCANTH(US) FAMILY (CALYCANTHACEAE)

SWEETSHRUBS (CALYCANTHUS SPP., SYN. BUTNERIA)

This group of about six species of ornamental shrubs, whereof only one occurs in the West, has no known browse interest save as a source of sickness or losses under overgrazed or other abnormal conditions. Chesnut (17) reports that the notably oily and sugary seeds of the eastern *Calycanthus fertilis* have the reputation of poisoning cattle in Tennessee, and on analysis by Harvey W. Wiley a high alkaloid content was found in them (144). A very poisonous alkaloid, calycanthin, resembling strychnine in its action, occurs in the frequently cultivated *C. floridus* and may perhaps be present in other species of the genus (95, pt. 2).

California sweetshrub (*C. occidentalis*), known also as California calycanth, strawberry-shrub, bubbly-bush, and sweet-scented shrub, the only member of the genus occurring in the West, is an erect branching shrub (fig. 6) 5 to 12 feet high, with thin and usually large leaves. The bark has a pungent, somewhat camphorlike taste. The species is common in many localities of the Sierra Nevada and northern Coast Range Mountains of California, occurring along or near mountain streams at medium or lower elevations. The flowers, crushed leaves, and wood have a peculiar fragrance likened by most persons to that of crushed strawberries. Ordinarily live-

stock seldom graze this bush and seem to have little or no taste for it. The species is generally reputed to be poisonous and is judged to be responsible for repeated cattle deaths occurring on the Shasta National Forest.



FIGURE 6.—California sweetshrub (*Calycanthus occidentalis*), a California bush apparently more or less poisonous to cattle. It is valued in cultivation for its showy, fruity fragrant blossoms

LAUREL FAMILY (LAURACEAE)

This aromatic family embraces all the true laurels, including the cultivated Grecian or European laurel (*Laurus nobilis*), also camphor-tree (*Cinnamomum camphora*), cinnamon (*Cinnamomum zeylanicum*), avocado (*Persea americana*), and the sassafras of the Eastern States.

California-laurel (*Umbellularia californica*, syn. *Oreodaphne californica*) has a large number of English names, including cajeput-tree, California bay (tree), cinnamon bush, Coos Bay laurel, mountain-laurel, Oregon myrtle, pepperwood, and spice tree. It is the only representative of the laurel family in the West.

California-laurel (pl. 3, B) is an evergreen and varies in habit from a matted network of sprawling or prostrate stems on ocean bluffs to a giant forest tree 175 feet high. It occurs from Coos and Douglas Counties, Oreg., to San Diego, Calif., mostly along streams, between about sea level and 2,500 feet elevation in the north and up to 4,000 feet in the south. It reaches its best development in rich moist bottom lands of southwestern Oregon. In drier, rockier sites it is ordinarily shrubby and is said to occur in such places only where the nature and dip of the strata permit the roots to elongate and reach moist levels.

This species is reported to be sparingly grazed by goats in southwestern Oregon. Otherwise grazing animals seldom, if ever, touch the plant, except perhaps in winter or other time of food shortage. It might possibly be injurious if eaten to a great extent. All parts of California-laurel are aromatic and presumably have active chemical properties. The leaves, when bruised, exhale a pungent, camphorlike aroma which frequently excites sneezing.

HYDRANGEA FAMILY (HYDRANGEACEAE)

Cliff fendlerbush (*Fendlera rupicola*) is an erect, intricately branched shrub up to 6 feet high, with opposite leaves of an oblong type not over 1 inch long, and profuse showy white-and-pink, 4-petaled blossoms shaped like a Maltese cross. It occurs from southwestern Colorado to Arizona and western Texas and south into Mexico, growing in full sunlight between about 5,000 and 8,500 feet, among rocks or in sandy or gravelly soils, in dry mountainous situations usually in the woodland type, often in association with juniper, piñon, sagebrush, and various gramas and muhlenbergias. As a rule fendlerbush does not appear to be highly relished by other stock, but Chapline found it to be of very high palatability for goats in New Mexico (15) and closely grazed by cattle in central Arizona, where on an overgrazed range it was taken by them apparently in preference to the oaks. When in full bloom this shrub is highly ornamental and under cultivation it should become increasingly popular for rockeries and like situations.

Several other species of fendlerbush and of the related genus, *Fendlerella*, occur in the Rocky Mountains, Great Basin region, and the Southwest. None of them have much forage value save for goats.

Cliffbush (*Edwinia americana*, syn. *Jamesia americana*) is a medium-sized diffuse shrub of the Rocky Mountains and Southwest, with rather large opposite ovate leaves. It is sometimes common and locally abundant and is occasionally nibbled by sheep but the palatability is ordinarily low. If it is taken heavily overgrazing is indicated. This bush, with its large white flowers, is very handsome and is now in cultivation as an ornamental.

Lewis mockorange (*Philadelphus lewisii*), known as wild syringa, has been legally adopted as the State flower of Idaho. It is the commonest species of the mockorange genus, frequently called syringa and represented by about 10 western species with showy, often very fragrant flowers. These plants appear to have little or no range significance, but more data concerning their palatability are needed.

Whipplea (*Whipplea modesta*), occasionally called modesty, grows as a low trailing diffuse undershrub in canyons and along streams in the Pacific tier of States at elevations between about 1,400 and 5,000 feet. It is abundant in places, but its palatability is low and it has at best only slight forage value.

GOOSEBERRY FAMILY (GROSSULARIACEAE)

GOOSEBERRIES (GROSSULARIA SPP.)

At least 23 species of gooseberry (merged by many botanists in the genus *Ribes*) are native to the Western States. Gooseberries vary from poor to fairly good browse, usually better for sheep than for cattle. Gooseberries are of much concern to the forester since they are, like the currants, intermittent hosts of the white pine blister rust.

Whitestem gooseberry (*G. inermis*, syn. *R. inerme*), known also as smooth, wine, or common wild gooseberry, which ranges throughout the Rocky Mountains and the Northwest, is probably as common and well known as any western gooseberry. This bush varies in height from 1 to 6 feet and is the smoothest of the western gooseberries, the spines and prickles being small and sparse. It grows best in rich, moist alluvial soils, often in association with willows and aspen in meadows or along streams, being found in open timber and in full sunlight, and occasionally in dry gravelly or rocky areas. The altitudinal range varies from about 2,000 feet in the north to about 9,500 feet in the south, but the plant probably is commonest between 6,000 and 9,000 feet through the greater part of its range.

Although in some few localities whitestem gooseberry is regarded as worthless it is generally considered to be at least fair for sheep. The wide distribution, local abundance, almost entire freedom from objectionable spines, and relatively large and delicate leaves make it one of the best members of the genus from the range viewpoint. The berries, reddish purple to bluish black (wine colored) when fully ripe, are very acid and make a good jelly.

Sierra gooseberry (*G. roezli*) of California is a fair sheep and cattle browse.

Watson gooseberry (*G. watsoniana*, syn. *R. watsonianum*) is confined to the Cascade Mountains of Washington, where it is reported by Lenzie as locally abundant and highly palatable to all classes of livestock in the fall.

OTHER SPECIES

Some of the western range species, notably thicket gooseberry (*Grossularia divaricata*, syn. *Ribes divaricatum*), of the Pacific coast region, and redshoot gooseberry (*G. setosa*, syn. *R. setosum*), a very bristly, spiny bush ranging from western Ontario to Sas-

katchewan, Idaho, Utah, and western Nebraska, are highly prized locally for their fruit. A number of the species (e. g., *lobbii*, *pinetorum*, and *speciosa*) are notably ornamental when in bloom.

CURRENTS (RIBES SPP.) *

Approximately 56 known species of currants occur natively in the Western States, if the gooseberries (*Grossularia* spp.), which many botanists unite with *Ribes*, are omitted. As a group *Ribes* are only fairly to moderately palatable to livestock, except possibly to goats, but their abundance and size of herbage crop give them considerable forage significance on some ranges.

Wax currant (*Ribes cereum*) (fig. 7) and **squaw currant** (*R. inebrians*), the latter frequently known also as rock currant and wine currant, two very similar species with small roundish leaves and whitish or pinkish flowers, are two of the commonest and most widely distributed species of this genus. These shrubs are common on dry, open slopes, frequently being among the dominant species of the locality, and on warm days filling the air with their characteristic musky odor. While their palatability is not as a rule high, at least in spring and summer, their abundance and the amount of herbage produced are so great that they are sometimes important factors in the carrying capacity, and their freedom from spines, rounded conformation, and mostly rather open stand are conducive to utilization. Analyses show that wax currant is nutritious, with a high protein content (143, p. 38).

Golden currant (*R. aureum*) occurs in all the far Western States, largely along stream banks. Its palatability varies from poor or fair to (for sheep) fairly good.

Gooseberry currant (*R. montigenum*), sometimes known as cloud-cap currant and false gooseberry, a small straggling bush 1 to 2 feet high occurring up to alpine elevations in the high mountains from British Columbia to California, New Mexico, and Montana, is, despite its usually small leaves and gooseberrylike prickliness, a species of more than average palatability.

Winter currant (*R. sanguineum*), known also as blood currant, with aromatic blood-colored flowers and bright-blue berries, is a very showy upland, riparian species of the Pacific region. In Washington, where it frequently comes in on Douglas fir burns, it is regarded as good for sheep and fair for cattle.

Sticky currant (*R. viscosissimum*), known also as hairy currant and sandbox currant, is a widely distributed and common species, occurring in mountain woods from British Columbia to California, Utah, Colorado, and Montana. It is a small or medium-sized, glandular-hairy bush with rather large leaves and black berries. This species, of which in general the palatability is fairly good, produces an enormous quantity of herbage which has the advantage of remaining green throughout the entire season until killing frosts occur.

* The aeciospores and urediniospores of the fungus (*Cronartium ribicola*) causing white pine blister rust infest, as the specific name intimates, species of this genus (29). Since this disease has now spread to parts of the West these native currants, many of which are undoubtedly potential alternate hosts for the disease, have assumed great silvicultural importance. There is still, however, much to learn regarding the relative susceptibility of our native currants and gooseberries to this fungus and the potential rôle they may play in the spread or control of the disease.



FIGURE 7.—Wax currant (*Ribes cereum*), one of the best known and most widely distributed native currants of the West. Its abundance and moderate palatability make it a rather important browse in some localities. Like all currants (and gooseberries), it concerns the forester wherever 5-needle pines occur, owing to its susceptibility to infestation from the white pine blister rust

Rothrock currant, sometimes called Wolf currant (*R. wolffi*), is one of the largest species (sometimes 12 feet high), ranging from Colorado and Utah to Arizona and New Mexico, in damp, shaded

sites between 7,000 and 11,000 feet elevation. It is ranked as fairly good cattle browse in parts of the central Wasatch Mountains of Utah.

American black currant (*R. americanum*), sometimes called black-bead currant, is one of the most widely distributed of all our native currants and because of its close relationship to the cultivated European black currant (*R. nigrum*), the most dangerous host of the white pine blister rust, would undoubtedly prove a menace in the vicinity of blister-rust infested or threatened plantations of any of the 5-needle pines.

ROSE FAMILY (ROSACEAE)

MOUNTAIN-MAHOGANIES (*CERCOCARPUS* SPP.)

Cercocarpus is a genus of about 19 species, of which 5 are wholly confined to Mexico, the remaining 14 occurring in the Western States, mainly in the Southwest, the Great Basin, and California. Only one species (*C. ledifolius*) occurs as far north and west as Washington and none are found in any part of Canada. The broader-leaved species are, in the main, palatable and valuable browse; the group with narrow leathery leaves is distinctly inferior to the others from a forage viewpoint.

Mountain-mahogany is somewhat cumbersome and none too appropriate a name for *Cercocarpus*, but the great weight of popular usage is overwhelmingly in its favor. Numerous other, and sometimes quite misleading, local names for these shrubs include birch-leaf mahogany, blackbrush, buckbrush, deer brush, hard-tack, sweet-brush, and tallow bush.

True mountain-mahogany (*Cercocarpus montanus*, syn. *C. parvifolius*) is ordinarily a shrub 2 to 10 feet high, branching from a thick base, but in favorable sites occasionally becoming a small tree 15 to 20 feet high or, rarely, even taller. The relatively small, birchlike, thickish leaves (fig. 8), broadest at the middle, and about one-half to 1¼ inches long, are more or less persistent.

None of the other species of *Cercocarpus* has a wider distribution than does *montanus*. It occurs from South Dakota and Montana to New Mexico, northeastern California, and Oregon, on dry ridges and slopes, ordinarily between about 4,000 and 10,000 feet, and is perhaps most characteristic of the "tension zone," or border line between the woodland and yellow pine types. It is frequently associated with Gambel oak, serviceberry, western yellow pine, juniper, manzanita, and various species of ceanothus, rabbit brush, and sagebrush, but is often the dominant species of the association and mostly occurs in a distinctly browse type.

True mountain-mahogany is one of the most important species of western browse. As a rule the palatability is good or even very good for all classes of livestock and occasionally excellent, especially for goats. The palatability is usually somewhat greater for sheep than for cattle and proportionately greater, as a rule, in fall and winter than in summer. The leaves persist until late fall,⁹ but the twigs furnish palatable feed yearlong. Wide distribution and local

⁹ Forsling and Nelson note that about 90 per cent of the leaves of this shrub are fallen in Utah by Oct. 15.



FIGURE 8.—True mountain-mahogany (*Cercocarpus montanus*), a widely distributed and important western browse plant: A, Fruiting spray; B, sterile spray with large leaves; C, flowering spray; D, individual fruit

abundance provide a large crop of forage, and the open stand and mostly moderate size promote good utilization. Although the species stands close grazing well the statement is sometimes made that, on the better sites where the arborescent habit is likely to

prevail, it may be desirable to graze closely enough to make the plants assume a bushy and more spreading form. However, to do this with any class of livestock but goats will cause overgrazing of the herbaceous vegetation and result in erosion. Continued overgrazing seriously affects forage production and may even kill the plants. On the whole true mountain-mahogany is somewhat better regarded from the forage standpoint in the Southwest and the Great Basin than it is farther north and west. In the mountainous regions of southern Utah this is almost uniformly regarded as the most palatable and important browse for cattle, sheep, and goats. Aldous and Shantz (2) figure the carrying capacity of mountain-mahogany range, including the abundant grasses occurring with the browse, as 20 to 40 head of cattle per section for the period of each year that the lands occupied by this type can be grazed without injury to the vegetation. The species is one of the most valuable winter feeds for deer and other herbivorous game animals.

Pammel (96, p. 38) quotes Greshoff to the effect that the glucoside amygdalin, partly convertible into HCN, occurs in true mountain-mahogany and states that this species must be regarded as poisonous. However, no authentic case of poisoning due to any species of *Cercocarpus* has ever been reported to the Forest Service and evidences of this particular species' value as browse are so abundant, uniform, and harmonious from all western regions that it is difficult to conceive of the species as harmful. It is probable that the quantity of glucoside in true mountain-mahogany is so small as to have only chemical rather than practical significance.

Silver mountain-mahogany (*C. argenteus*) and **birchleaf mountain-mahogany** (*C. betuloides*, syn. *C. betulaeifolius*), the former of the Southwest and the latter of California, are two species very closely related to *C. montanus* and of similar palatability. *C. argenteus* is one of the most valuable goat browses of New Mexico and Arizona, usually being ranked as excellent, and it is well relished also by cattle and sheep. *C. betuloides* is frequently abundant enough to be an important factor in the carrying capacity of cattle and sheep ranges and often attains tree size.

Curlleaf mountain-mahogany (*C. ledifolius*), frequently known simply as curlleaf or mountain-mahogany (3), is much the commonest, most widely distributed, and best known of the narrow-leaved and hard-leaved species. It ranges from eastern Washington to California, Arizona (north of the Grand Canyon), Colorado, and Montana, occurring between about 2,000 and 4,500 feet in the northern and northwestern and up to 9,000 feet or perhaps even higher, in the southern part of its range. It is found mainly on warm dry rocky ridges, mostly on southern, the drier western, or (in its Pacific States range) on eastern slopes, but is sometimes observed on clayey or loamy soils. It is perhaps the largest and most typically treelike of the species of the genus. On winter range, or very late and very early in the season when other feed is scarce curlleaf mountain-mahogany has slight forage value; otherwise it is ordinarily deemed next to worthless. The evergreen nature of the leaves renders them subject to yearlong utilization. Standley (126) states that the Gosiute Indians of Utah used the wood of this species in making their bows.

OTHER SPECIES

Certain species of mountain-mahogany, such as *C. arizonicus* and *C. intricatus* of the Great Basin and Southwest, have leaves much narrower and smaller than those of *C. ledifolius*; and while not necessarily worthless, are noticeably inferior even to that species from the browse standpoint.

Several mountain-mahogany species, particularly *C. breviflorus* and *C. eximius*, which have rather small thickish but not leathery leaves, are intermediate in forage value between the *montanus* and *ledifolius* groups. *C. breviflorus* is considered one of the best browse species for all classes of livestock, but especially sheep and goats, in southern New Mexico. *C. eximius* is taken freely by all classes of livestock and is ranked as a first-class goat browse in the mountains of New Mexico.

ROSES (*ROSA* SPP.)

At a moderately conservative estimate about 55 species of native roses occur in the Western States, most of them having some value as browse, and several as cultivated ornamentals. Also, the eglantine (*Rosa rubiginosa*, syn. *R. eglanteria* Mill., not L.), often called "sweetbrier," a native of the Old World, has escaped from cultivation and become naturalized in parts of the West. For sheep in the Modoc region of northeastern California it has been reported as fair browse, but worthless for cattle and horses in that locality. The genus embraces the floral emblems of four States: Cherokee rose (*R. laevigata*, of which *R. cherokeensis* and *R. sinica* are synonyms), a native of China, widely naturalized in the Southeast and, in the past, considered by many as native, is the State flower of Georgia; the wild rose is the State flower of Iowa; the rose, of New York; and the wild prairie rose, of North Dakota.

Fendler rose (*Rosa fendleri*) (fig. 9, A) is a relatively small shrub, seldom over 2 or 3 feet high, with slender branches, and prickles that are short, slender, straight, and generally sparse. The leaflets are mostly thin, dark green, and usually five or seven to the leaf. The pink, showy flowers appear from May to July.

Few western roses have as extensive a range as that of *Rosa fendleri*, the species occurring from South Dakota and Montana to Utah, Arizona, western Texas, and south into the mountains of northern Chihuahua, Mexico. Fendler rose grows mostly in open woods between about 6,000 and 9,500 feet in elevation, typically in rich deep moist loam with abundant humus, but also in drier and sandy soils; in the seemingly dry sites considerable subirrigation is probably available. Frequent woody associates of Fendler rose are maple, willow, aspen, alder, serviceberry, and various oaks.

Because of its abundance, wide distribution, delicate twigs and foliage, and relative freedom from spininess this rose is one of the most important browse species of this genus. Its moderate size is conducive to full utilization and may sometimes subject it to injury. It is ordinarily cropped only moderately, but occasionally closely, by both cattle and sheep.

Macoun rose (*R. macounii*), **Mancos rose** (*R. manca*), **Maximilian rose** (*R. maximiliani*), and **Woods rose** (*R. woodsii*) are familiar western roses related to Fendler rose and occasionally confused with



FIGURE 9.—Two important browse rosebushes of the West, Fendler rose (*Rosa fendleri*) and bald-hip rose (*R. gymnocarpa*): A, Flowering spray of Fendler rose; E, fruit (hip or haw); B, flowering spray of bald-hip rose; C, leaf of same with enlarged but fewer leaflets; D, fruit of same showing deciduity of sepals and styles

it to some extent. All are fair or fairly good sheep and cattle browse, but none are as abundant and widespread as Fendler rose or of equal forage value. Macoun rose is a small or medium-sized bush at mid-

dle to subalpine elevations, ranging from British Columbia to Manitoba and south to Utah and northern New Mexico. It has straight but down-bent, rather prominent spines. Mancos rose has a limited range, from southwestern Colorado, through southern Utah, to northern Arizona, in canyons, draws, and near streams, in sandy or gravelly soils between 6,000 and 9,000 feet. It is, however, often very abundant in this region, and its moderate size, usual accessibility, abundance, relative freedom from spines, and relatively high palatability to cattle, horses, and sheep, combine to make it one of the important browse on many areas within its range. Maximilian rose is a northern species about equal to Macoun rose in palatability. Woods rose is a nonglandular species, with relatively large and curving prickles, ranging from British Columbia to Nevada and western Kansas; its palatability is not high, but it is in some localities sufficiently abundant to make it a factor in the forage crop.

Cluster rose (*R. pisocarpa*) ranges from British Columbia to Oregon and Idaho, possibly also to California and Utah. It has slender stems armed with straight, rather long but slender spines. While common, this species usually occurs in scattered groups along streams and dry ravines in the mountains of its range and is almost unanimously held to be a good sheep browse. An analysis shows it to be remarkably high in protein (143, p. 40). Closely akin to it is *R. ultramontana*, a tall rose ranging from Oregon to northern California, Nevada, and western Montana, and often a range shrub of value.

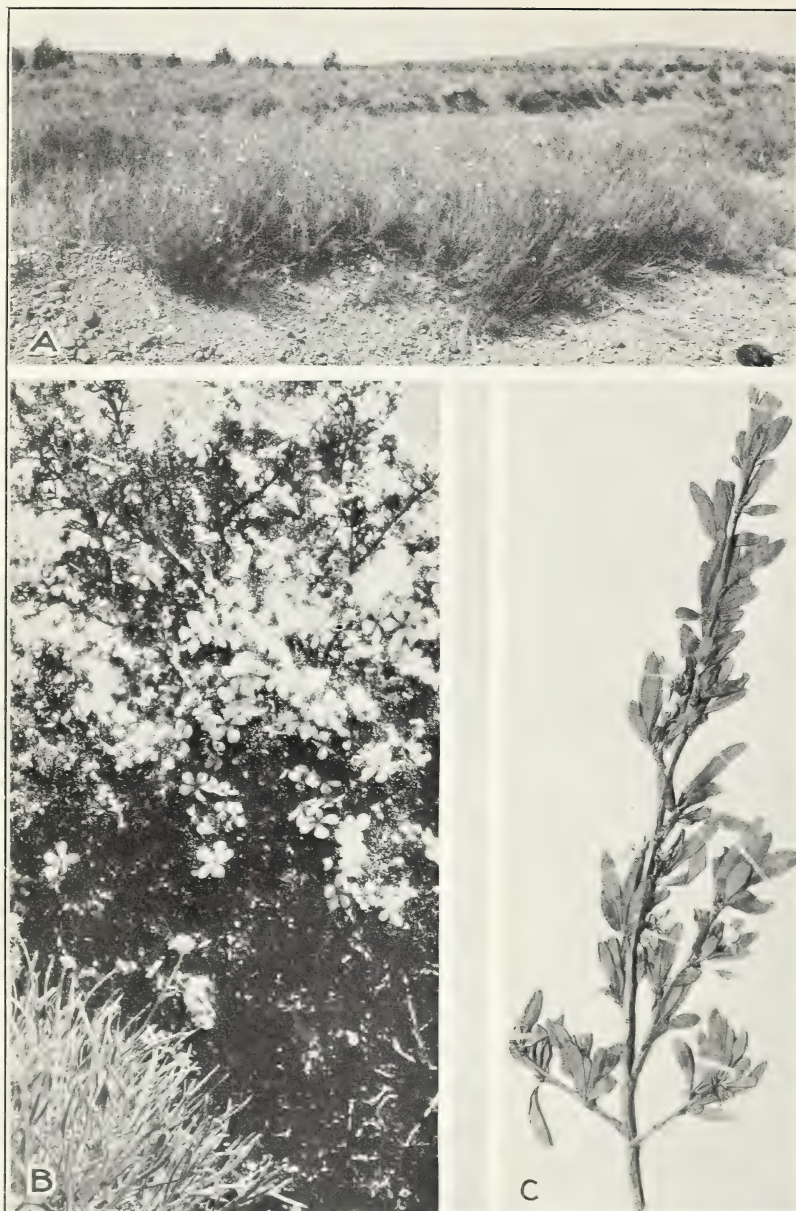
Bald-hip rose (*R. gymnocarpa*) (fig. 9, B, C), which gets its name from the character of its fruit from which the styles and upper part of the calyx are deciduous (fig. 9, D; compare E), is a weak-stemmed bush, 1 to 10 feet high, the slender branches smooth or else sparsely armed with straight, slender prickles. This is a northwestern species, ranging from Vancouver Island and southern British Columbia to middle California, Idaho, and western Montana. It is common in conifer forests and other wooded districts, especially in the yellow pine belt, chiefly between 1,500 and 4,500 feet elevation, and very seldom above 5,000 feet except possibly at the extreme southern limit of its range. Its soil is a moist but usually loose sandy or gravelly loam, often with a thick humus layer, although the bush may also be observed in superficially dry clayey soils and alluvial washes where there is subirrigation. *R. gymnocarpa* mingles commonly with yellow and white pine, Douglas fir, larch, twinflower, hollygrape, salal, oceanspray, pyrola, and ferns. Although held by some to be only fair browse, all things considered it is generally regarded as one of the best of the native western roses. It has been named as the most palatable member of the genus in Washington and Oregon for both sheep and cattle, especially in the fall, when its palatability ranks from very good to excellent. Coville ranks it as one of the favorite browsing plants for sheep in the heavy west slope forests.

Engelmann rose (*R. engelmannii*) occurs from the Dakotas to Montana and Colorado. It is rather remarkably free from spininess though bristly, and its tender foliage is esteemed as choice sheep feed; it is seldom, if ever, over about 20 inches high.



A, Oregon hollygrape, or Oregon grape (*Odoskemon aquifolium*), the State flower of Oregon. Worthless as forage, but valued as an ornamental and drug plant; the berries are used for jelly; B, California-laurel (*Umbellularia californica*), the only member of the laurel family in the West. When of timber size it is one of the most valuable Pacific hardwoods. Shrubby forms are occasionally browsed by goats

F 197494 F 197499



F184043 F165110 F187546

A, Apache plume (*Fallugia paradoxa*), in full bloom along an arroyo bank, Tusayan National Forest, northern Arizona; B, cliffrose (*Cowania stansburiana*) in full bloom, on the Manti National Forest, Utah. An important browse, especially in winter, for both livestock and game; C, squaw-apple (*Peraphyllum ramosissimum*), a common and abundant shrub in the Great Basin and, on some areas, an important browse

Say rose (*R. sayi*), which is regarded by some botanists as identical with Bourgeau rose (*R. acicularis bourgeauiana*), is also low and free from spininess. It occurs generally throughout southern Canada and in the Northeastern States, and crops out again in the West from Minnesota to Montana and south to Colorado. It has thicker leaves than Engelmann rose and is not quite so palatable but is sometimes abundant and an important local source of forage.

Nootka rose (*R. nutkana*), one of the commonest of the northwestern roses, ranges from Alaska to California, Colorado, and western Montana. Its spininess and prickliness render it inferior in palatability for sheep and cattle to some other species.

California wild rose (*R. californica*) is confined to California and is generally regarded as the commonest wild rose of the State, being found for the most part along or near watercourses at lower to middle elevations, often forming small thickets. It is fairly good browse for both cattle and sheep and sometimes furnishes forage in great abundance.

Blackstem rose (*R. melina*) grows at elevations of between 6,000 and 10,000 feet from Wyoming to Utah and northern New Mexico and, in the Wasatch and Uinta Mountains especially, is highly regarded on both cattle and sheep ranges.

Pear-hip rose (*R. pyrifera*), so named because of its curious pear-shaped fruits or hips, ranges along stream banks and in other moist situations, usually under shade, in the mountains from Montana to Wyoming, Utah, Nevada, and California; all classes of livestock graze it.

Spalding rose (*R. spaldingii*) grows in woods, mainly in the yellow pine type, at elevations between 3,500 and 6,500 feet, in both dry and moist, sandy or gravelly loams, from British Columbia to Idaho, Wyoming, Utah, northern California, and Oregon (east of the Cascades); it is comparatively common on dry alluvial bottoms associated with willows and spirea. Where abundant and accessible it is ordinarily held to be very palatable, especially to sheep, being ranked on many Idaho ranges as very good feed for that class of livestock, and in northern California as good sheep feed and fair cattle and horse feed. Young shoots of this species are browsed by both sheep and cattle in Washington and Oregon, but are hardly touched after the thorns harden.

Ground rose (*R. spithamea*), which attains a height of only 2 to 12 inches, is the smallest of our western roses. It occurs in southwestern Oregon and northern California. Locally very common in open (chiefly pine) woods, especially along streams and on moist hillsides, it makes fair to good sheep and cattle feed wherever abundant.

OTHER IMPORTANT GENERA

Cliffrose (*Cowania stansburiana*) (pl. 4, B) is known also by a variety of local names, including quinine-bush, bitterbrush, and bitter aloes. It sometimes appears in literature under the name *Cowania mexicana*, actually a distinct and wholly Mexican species, differing in floral and leaf characters from *C. stansburiana*. This shrub is ordinarily much branched and spreading and 3 to 12 feet high, but under the most favorable circumstances, notably near the

south rim of the Grand Canyon and the near-by San Francisco Peaks, sometimes becomes a small tree 20 to 25 feet high. Aside from two species indigenous to western Texas this is the only species of *Cowania* occurring in the United States.

Cliffrose occurs from southern Colorado and Utah to California (east of the Sierra Nevada), Sonora, Chihuahua, and New Mexico. It is found mostly in dry rocky situations on foothills and mesas up through the woodland type to the lower fringe of the yellow pine belt, between about 4,000 and 8,000 feet. While perhaps most characteristic of limestone areas it grows also on granitic, volcanic, and other igneous formations, often on east and south slopes, and is frequently associated with juniper, piñon, mountain-mahogany, serviceberry, sagebrush, live oak, and other moderately xerophytic shrubs and small trees.

Although the herbage is bitterish, cliffrose is an important and valuable browse species for both cattle and sheep, the persistent leaves and the more tender twigs being available for yearlong use. The growth habit of the leaves—crowded together for the most part at the ends of the short, stubby, almost spiny twigs—facilitates their being cropped and has even a tendency to encourage too close grazing and so render the bush more liable to stunting. The branches are rather brittle, and under prolonged overgrazing the bushes are very liable to be broken down and severely damaged. Instances have, however, been noted on the Kaibab Plateau where grazing of cliffrose seemed to result in the production of a greater number of leafy shoots, apparently making the forage production greater than under total protection.

The species is an important element in the forage crop of many deer ranges, especially as a source of winter sustenance.

Apache plume (*Fallugia paradoxa*) (fig. 10), also known as fallugia and poñil, attains a height of about 7 feet, but 2 to 3 feet is about the average stature; it has a diffusely branched habit, with slender branches and a whitish or pale-gray bark; the small, lobed leaves are evergreen. It is found from western Texas and Colorado to southern Nevada, southeastern California, and south into Mexico. While reaching its best development in deep, moist, rich sites such as open canyon bottoms and sides of arroyos (pl. 4, A), Apache plume is found in a great variety of soils, including dry rocky ridges, from the lower brush types through the woodland (piñon-juniper) type to the open yellow pine belt; it is most common in sandy or clay loams and in the more southerly parts of its range. In Arizona and New Mexico it is most common between about 5,000 and 7,500 feet, but extends up to at least 8,500 feet in northern New Mexico.

The species is common rather than abundant and, in general, is of moderate or fair to low palatability for sheep, goats, and cattle, although it doubtless is closely grazed on overgrazed ranges. In spite of its inferior palatability, the evergreen and often rather bunched, or fascicled, leaves of Apache plume and its relatively long and delicate twigs make it available yearlong and give it some importance on winter range. It endures close grazing very well and



FIGURE 10.—Apache plume (*Fallugia paradoxa*), a common southwestern shrub that is of browse value on winter range

shows excellent recuperative powers. Talbot,¹⁰ in a report based on a number of years' intensive study in that locality, calls attention to the fact that Apache plume is a valuable erosion-control plant in many swales, little valleys, and arroyos in the Southwest.

¹⁰ TALBOT, M. W. HOW TO JUDGE SOUTHWESTERN RANGE CONDITIONS, 1924. [Mimeographed.]



FIGURE 11.—Bitterbrush, or antelope-brush (*Purshia tridentata*), one of the most widely distributed and abundant western shrubs, and extensively cropped by sheep, goats, cattle, deer, and antelope. It is especially valuable on winter, late fall, and spring range: A, sterile spray; B, flowering spray; C, fruiting spray; D, fruit; E, leaf

Bitterbrush (*Purshia tridentata*) (fig. 11) is one of the most widely distributed western shrubs, ranging from Montana to New Mexico, California, Washington, and British Columbia. It is an

intricately branched but erect bush, with yellow flowers appearing from May to July, the moderately "tailed" fruits usually being fully formed by early August. This species, as well as numerous other western shrubs, is frequently called buckbrush; other English names often applied to it are antelope-brush, black sage, deer brush, and quinine brush. The plant appears in some of the books under the name *Kunzia tridentata*, but *Purshia* is the older generic name.

Bitterbrush occurs on dry plains, hills, and mountain sides, mostly in well-drained, sandy, cindery, gravelly, or rocky soils, most commonly on south or southwestern slopes, up to about 3,500 feet elevation in the North and Northwest and 9,000 feet toward the southern end of its range. It is probably never found in typically wet or shaded situations and is frequently associated with species of sagebrush, snowberry, mountain-mahogany, serviceberry, and oak brush. (Pl. 5, A.)

Despite the characteristic taste of its herbage, alluded to in the common name "bitterbrush," or perhaps partly because of that fact, *Purshia* is one of the most important species of browse plants occurring on western ranges and in some places is regarded as the most important single browse species in the locality. The abundant wedge-shaped 3-toothed leaves and the younger twigs, while seldom touched by horses, are extensively cropped by sheep, goats, and cattle, especially sheep. As the species is usually abundant, sometimes being the chief feature of the vegetational landscape, it is an important element of the carrying capacity. Its palatability appears ordinarily to be greatest in spring, winter and late fall, when the evergreen foliage and usual large size of the plant enhance its utility. On sheep range its value is increased by an admixture of grasses and weeds. In general, bitterbrush may be stated to have more value in southern Idaho, Utah, and the Southwest than in Oregon and the Northwest generally. In northern (especially northeastern) California, however, it is usually held to be good to excellent browse on sheep range.

In many places of the West *Purshia* is one of the chief browse plants for game animals, being especially important as a winter and early spring feed for deer and antelope.

Secondary Rosaceous Genera

Chamiso (*Adenostoma fasciculatum*), often called chamise and greasewood, is an evergreen, somewhat resinous, mostly spreading shrub 2 to 10 feet high, or occasionally higher, having small fascicled leaves (fig. 12), and small white flowers. It occurs in the California Coast Range (rarely in the Sierra foothills) from Mendocino and Lake Counties south to Lower California, and is one of the most common and characteristic chaparral species of California, from lower middle to high elevations; often forming a transition belt between the foothill and yellow pine types. It quickly invades and occupies burns, and it is possible that its present abundance is due in large measure to this fact. Chamiso is especially characteristic on long steep slopes where it forms a chamisal, or dense impenetrable thicket, which travelers have frequently likened to the heaths of the Old World. It is almost everywhere regarded as a pest, but it is possible that it and its congener, redshanks, sometimes called yerba

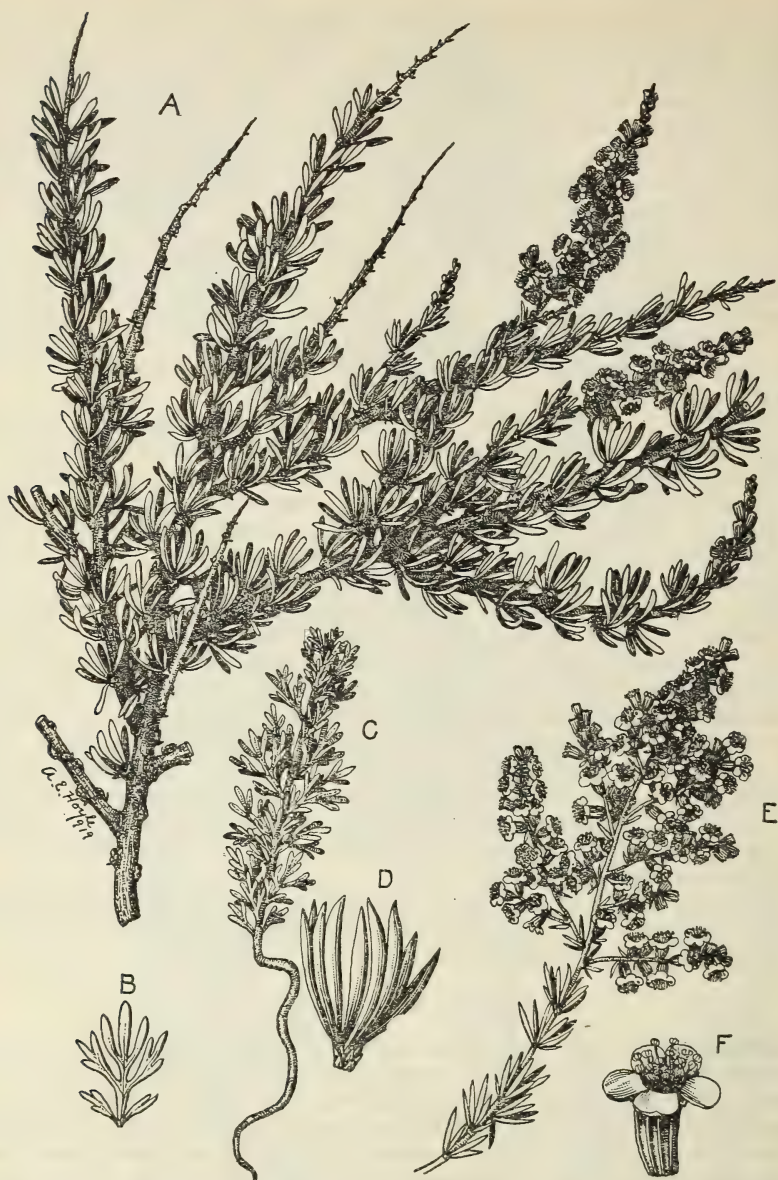


FIGURE 12.—Chamiso (*Adenostoma fasciculatum*), a characteristic chaparral species of California, practically worthless for grazing: A, Mature spray; B, seedling leaf; C, seedling; D, fascicle of mature leaves; E, flowering twig; F, flower

del pasmo or ribbon-wood (*A. sparsifolium*), may have medicinal properties (118).

In an experiment on the California National Forest following a burn, many chamiso seedlings came in the first year and the seedling leaf type (fig. 12, B, C) was found to be fairly palatable to sheep and cattle. Also the rather succulent and delicate sprouts produced

by chamiso the first season following the fire were extensively grazed by livestock but after the first year these sprays were largely inedible. As a whole the species is practically worthless on the range, its only claim to importance being its abundance.

Adenostoma sparsifolium, the other species of this genus, occurs in southern and Lower California, being found mainly in looser soils. It has reddish bark on the older stems and yellowish green on the younger twigs, sparse and scattered leaves, and larger, very fragrant flowers. Mexicans sometimes call it palo amarillo.

Bearmat (*Chamaebatia foliolosa*), also known as bear-clover, fern-bush, mountain misery, tar-bush, and tarweed, is a low, many-branched, resinous, odorous, evergreen shrub about 1 or 2 feet high; the thrice-pinnate, fernlike leaves are 2 or 3 inches long, each minute leaflet usually tipped with a yellowish resin gland. The flowers appear from May to July. The species is indigenous to the Sierra Nevada of California, occurring in large patches, often comprising a complete local understory in the mixed conifer type, mostly between 3,000 and 7,000 feet. Plate 2, B shows the characteristic type in which bearmat is found. Occasionally a sheep or cow may be observed to nibble this bush a little but, on the whole, it may be regarded as worthless forage. From the grazier's and forester's viewpoints its chief significance is that it is a plentiful, undesirable plant that prevents useful species from covering the ground. Munns (91) has shown that the species retards restocking of burned-over conifer stands and the growth of conifers. The species has been considered for commercial distillation of its resinous oils.

Tansybush (*Chamaebatiaria millefolium*), frequently called bearmat, bear-clover, chaparral millefolium or milfoil, fernbush, and mountain misery, is an odorous glandular-pubescent and somewhat woolly shrub, 2 to 5 or occasionally 8 feet high, ranging from northeastern California and eastern Oregon (where it is usually rather rare) to western Wyoming and, through Nevada and Utah, into western and southern Arizona. It is a denizen of steep slopes, dry ridges, rocky canyons, lava beds, and other dry or fairly dry sites, in both limestone and igneous formations, chiefly in the yellow pine type and between about 4,000 and 9,000 feet elevation. Although ordinarily considered to be worthless and unpalatable it is regarded in parts of Arizona as fair sheep and goat browse.

Blackbrush, or blackbush (*Coleogyne ramosissima*), is a bush 3 to 6 feet high with short and rigid spinelike twigs, which ranges from southwestern Colorado to Arizona and the Mohave Desert region of California. It is the dominant species of the blackbrush formation in the Great Basin and inhabits desert mesas and foothills in piñon-juniper brush types. The leafage, although too small and scanty to furnish much sustenance, is persistent and therefore available yearlong. In the Dixie Forest region of southern Utah blackbrush is widely distributed and locally abundant and occasionally furnishes some feed for cattle and sheep in the winter. Its spiny character and thick growth make it a pest to the traveler.

Bush cinquefoil (*Dasiphora fruticosa*, syn. *Potentilla fruticosa*) (fig. 13), often called shrub or shrubby cinquefoil and known locally also as buckbrush, ninebark, and yellow rose, is a much-branched, often sprawling, shreddy-barked shrub, seldom over 3



FIGURE 13.—Bush cinquefoil (*Dasiphora fruticosa*), a low, very widely distributed bush, of low to fair palatability to livestock; important because of its commonness: A and D, Flowering sprays, showing typical leaf type and shreddy bark; B, fruiting spray, showing the *tenuifolia* type of leaf; C, individual leaf, typical form

feet high and mostly from 10 to 24 inches. The dark slender stems are tough and twisted; the leaves are leathery and persistent.¹¹

Bush cinquefoil is widely distributed in the northern hemisphere, occurring in Europe and Asia, and in North America from Greenland and Labrador to Alaska and south to California, New Mexico, Minnesota, Illinois, and New Jersey. It has a wide altitudinal variation; and while essentially a species of cool climate, moisture seems to be a more controlling factor in its distribution than temperature. It occurs from the yellow pine type to above timber line, being especially characteristic of moist rocky subalpine meadows, along streams, or about cold seeps and springs, mostly in damp to wet, peaty, sandy, or clayey loams.

The flowers are produced season long, from early June until frost.

The palatability of bush cinquefoil is seldom high, rarely above secondary, and frequently negligible. Its forage value varies materially with different conditions. On the whole it is distinctly inferior and practically worthless for cattle, but for sheep and goats on high summer range, especially in the Southwest and in southwestern Montana and contiguous portions of southeastern Idaho, it is sometimes a rather important browse. Its low habit and spreading branches are conducive to utilization. The persistency of the leaves would also be in its favor were this not offset by the normal occurrence of the shrub on summer range only. In the unusual instances where it is found at lower elevations it is apt to be more valuable for fall browsing. The leaves, while abundant and of good size, are coarse in texture and have an astringent taste. Rydberg (105, p. 5) states that in Siberia the dried leaves are used as a substitute for tea.

Mallow ninebark (*Opulaster malvaceus*, syn. *O. pauciflorus*), perhaps the most abundant and valuable of the ninebarks, ranges on dry, rocky river and lake banks and along small mountain streams from western Wyoming to western Montana, Idaho, British Columbia, Oregon, and Utah. The species produces an immense amount of foliage which in some places is lightly grazed, but in others (notably in Utah, Idaho, and eastern Oregon) constitutes fairly good browse for sheep and goats and occasionally for cattle also. Ninebarks (*Opulaster*¹² spp.) are represented in the West by about nine montane species, though some less conservative authorities would increase that number considerably. They have a bushy habit and currantlike leaves, and usually occur along streams, in canyons and woods, or on rocky slopes and ridges. On the whole their palatability is inferior, but in some places they furnish fair sheep, goat, and cattle browse. A number of them are in the horticultural trade as ornamentals.

BLACKBERRY - RASPBERRY - DEWBERRY - BLACKCAP - THIMBLEBERRY - CLOUDBERRY AGGREGATION (RUBUS SPP.)

A conservative specific concept would accept approximately 25 western species of *Rubus*, including the segregated genera, *Bossekia*

¹¹ The timber-line and above-timber-line form of the species is apt to have very narrow leaflets (as well as to be much gnarled and dwarfed) and has been described as a distinct variety or species, *D. fruticosa tenuifolia* (Willd.) Rydb. (= *Potentilla tenuifolia* Willd.), but it is questionable whether, in view of the variations of the species, it is desirable to give the narrow-leaved state a separate name.

¹² Rafinesque's genus *Physocarpa* (1836) and Maximowicz's *Physocarpus* (1879) are synonyms of Medicus's *Opulaster* (1799).

(=Rubacer) and Oreobatus, of some authors, that have the stems at least to some degree woody, the canes of the majority of the woody species being biennial. A few of these have limited forage significance; none is important. The densely prickly stems, sprawling and tangled growth, usually very local occurrence, and at best secondary palatability, are the main factors involved in the forage inferiority of the group. Many of these plants are locally prized, however, for their very palatable and abundant fruit.

Whitebark raspberry (*R. leucodermis*) is fair sheep browse in parts of the Northwest.

Western red raspberry (*R. melanolasius*, syn. *R. strigosus* of western authors), common in some sections of the Wasatch Mountains, is frequently grazed by sheep, and sometimes by cattle, as closely as the thorns will permit; it is probable, however, that more conservative stocking of the range would result in lessened use of this species.

Whiteflowering raspberry, often called thimbleberry (*R. parviflorus*, syns. *Bossekia nutkana*, *B. parviflora*, *Rubacer parviflorum*, and *Rubus nutkanus*), is a very widely distributed and common woods species, accounted fair sheep feed in parts of the Southwest and elsewhere. It is occasionally nibbled by cattle, but is mostly poor or worthless.

Salmonberry (*R. spectabilis*) of the Northwest is seldom grazed to any material extent, but in the Wenatchee Forest region (west-central Washington) ranks as fair feed for sheep. Its large, deliciously flavored, salmon-colored berries are everywhere prized but especially so in Alaska, where it is reported that the new growth of the species is taken by the deer also.

ROCKSPIREAS (SERICOTHECA SPP., SYN. HOLODISCUS)¹³

About five species of the spirealike genus *Sericotheca* occur in the West. Their forage value is very limited, the foliage normally being of low palatability.

Creambush (*S. discolor*, syns. *Holodiscus discolor*, *Schizonotus discolor*, *Spiraea discolor*) (fig. 14) ranges from British Columbia and Washington to Idaho and California. A luxuriant and largely coastal form of this (var. *ariaefolia* of some authors) occurs in cultivation under the name oceanspray.

Bush rockspirea (*S. dumosa*, syns. *Holodiscus dumosus*, *Spiraea discolor dumosa*, *S. dumosa*) is very similar to creambush but of warmer, more xerophytic climates, occurring from Wyoming to Oregon, eastern California, Arizona, and Chihuahua, Mexico. These are probably the two commonest, most widely distributed, and best known species of the genus. They are usually regarded as of distinctly minor range value or unimportant; a few observers, however, have locally ranked them as fair browse for sheep and cattle, at least in the fall.

¹³ Some (especially of the older) botanists have merged the genus in *Spiraea*, but that is bad botany in view of the great differences, especially in fruit characters, between the two genera. *Sericotheca* has also been confused by some with *Schizonotus*, but that is an Asiatic genus with pinnate leaves. *Sericotheca* seems to have no English name in general use.



FIGURE 14.—Creambush (*Sericotheca discolor*), occasionally fair fall browse for cattle and sheep. The luxuriant coastal form (var. *ariaefolia* of some authors) is cultivated as an ornamental under the name oceanspray

SPIREAS (SPIRAEA SPP.)

This northern genus of about 75 species, represented in the Western States by about 11 species, is frequently called meadowsweet or (those species with pyramidal inflorescence) steeplebush. The palatability of these bushes is usually low, sheep and cattle nibbling them only a little when very hungry or short of browse, or more often leaving the plants untouched. In the East abundance of native spireas in pastures is a common index of overgrazing. However, the leaves are often tardily deciduous and, after frost, are occasionally taken readily by stock.

Menzies spirea (*S. menziesii*), a northwestern species with moderately thin and smooth leaves and pyramidal heads of rose-colored flowers, is regarded locally as the most palatable member of the genus in that region, being fair to good forage in the fall for both sheep and cattle.

APPLE FAMILY (MALACEAE)

SERVICEBERRIES (AMELANCHIER SPP.)

The serviceberry genus (*Amelanchier*), often called sarvisberry, juneberry, and shadblow, is a large one, almost world-wide in distribution but probably best represented in the western United States where perhaps about 24 species occur, using a more conservative specific concept. It is ranked among the important and highly palatable groups of goat browse, sometimes good winter sheep feed, but of only moderate value on summer cattle range.

Common serviceberry (*Amelanchier alnifolia*) (fig. 15), known variantly as saskatoon, alderleaf sarvisberry, western juneberry, and pigeon berry, the commonest and most widely distributed of the western members of the genus, is normally a shrub 3 to 10 or occasionally 15 feet high, but under the most favorable soil and climatic conditions it becomes a small or medium-sized tree 20 to 30 or even 40 feet high. The copious white flowers appear from May to early July. The fruit is juicy, sweet, and edible.

Taking a conservative view of specific limitations it may be stated that common serviceberry ranges from western Ontario and Michigan to Yukon, (Alaska?) and British Columbia and south to California, New Mexico, the Dakotas, and Minnesota. It is difficult, if not impossible, to give the exact range of this species owing chiefly to differences of taxonomic opinion. In the Northwest it occurs from nearly sea level up to about 4,500 feet; in south-central California and in northern Arizona and New Mexico its altitudinal distribution is largely between about 7,000 and 9,500 feet; in the Rocky Mountains it is found from 2,500 to 9,000 feet, depending mainly on the latitude. It occurs on all slopes, in both moist and rich and in dry rocky and rather sterile soils, growing in canyons and gulches, along streams, mountain slopes, and ridge tops. The species grows mostly in brush and other browse types, usually scattered but often abundant, frequently associated with aspen (mostly in thin stand), chokecherry, thimbleberry, maples, Gambel oak, and manzanita.

In a good many places common serviceberry is a forage species of the first rank. In general the young foliage is more palatable



FIGURE 15.—Common serviceberry, or saskatoon (*Amelanchier alnifolia*), the most common and widely distributed western member of the genus and in many places an important browse plant, especially in spring and fall: A, Sterile spray; B, flowering spray; C, fruiting spray

and is grazed more freely than the mature leafage, although, owing to local forage conditions, the time of greatest palatability is sometimes taken to be the late summer and fall. The nutritive properties of the species are well known. Wilson, Dinsmore, and Kennedy (143, p. 41) give in Table 1 analyses of this species.

TABLE 1.—*Chemical analysis of common serviceberry, air-dry basis*

	Constituent					
	Water	Ash	Ether extract	Crude fiber	Crude protein	Nitrogen free extract
	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>
Large-leaved or creek form.....	4.26	1.85	6.07	22.60	13.76	51.44
Small-leaved or hillside form.....	6.13	7.16	10.26	13.50	15.12	47.38

When the enormous distribution of the plant is taken into consideration as well as its wide adaptability, abundance, accessibility, prolificacy of herbage, and utilization by all classes of grazing animals, the range importance is obvious. In parts of western Montana and Idaho where there is abundant other and more palatable feed common serviceberry has been reported as but slightly cropped by sheep. In numerous places, however, the species is ranked as very good or even excellent for sheep, particularly in Wyoming, Utah, Idaho, Nevada, and California on ranges where other more palatable feed is not abundant. For cattle it is generally considered fair to good forage.

In the region from British Columbia, and possibly Alaska to California and Montana (and perhaps occasionally eastward), is a form known as **Pacific serviceberry** (*A. florida*), often called flowering, or showy, serviceberry and by many authors considered indistinguishable from *A. alnifolia*. It has, however, thinner (mostly narrower) leaves more glabrous below, and larger, showier flowers than typical *alnifolia* and probably is more often arborescent. It perhaps may better be regarded as a coastal or northwestern form of *alnifolia*. On the whole, the foliage of this form is rather more palatable than that of typical *alnifolia*. It occurs in Idaho between about 2,500 and 7,000 feet elevation, often in association with aspen, willow, snowbrush, and chokecherry, and in many localities abundantly. In northeastern California it is ranked among the most important browse plants on many ranges and in Washington is considered more valuable for cattle than sheep, especially during late summer and fall.

The berrylike fruits (more strictly pomes or miniature apples) of both *A. alnifolia* and *A. florida* are much valued for human consumption and, collected and dried, were an important source of food among the Indians.

Mountain serviceberry (*A. oreophila*), known also as hairy mountain sarvis, is a low, hairy-leaved shrub, growing in clumps, and ranging from the Black Hills region of South Dakota to New Mexico, Nevada, and southern Montana. It occurs on slopes and in canyons, between about 5,000 and 8,000 feet elevation, in browse and woodland types and mostly in rather loose and dry, sandy, gravelly, or rocky soils. The flowers appear from the middle of May through June and the dark insipid fruit ripens in September and October. It is often locally abundant, is accounted fair sheep feed, but is mostly worthless or poor for cattle.

Cluster serviceberry (*A. polycarpa*) ranges from southwestern Wyoming to northwestern New Mexico and southern Utah (prob-

ably also occurring in northern Arizona). It is common between about 7,000 and 11,000 feet in moist conifer woods. The fruit is exceedingly profuse and, while edible, somewhat insipid. The browse value of this species varies in different localities and at different seasons. C. N. Woods regards it as excellent forage in the Dixie region of southwestern Utah; in some other areas, however, (for example, the La Sal Mountains of southeastern Utah), it is considered inferior.

Redbud serviceberry (*A. rubescens*), with small, unusually narrow and acute, many-toothed leaves and red flower buds, occupies a belt stretching from southwestern Colorado, through northwestern New Mexico, southern Utah, and Nevada, and possibly extending down into northern Arizona. It inhabits rocky, often granitic situations and in many localities makes up a considerable part of the vegetation. In the spring, as the leaves unfold, goats and sheep take it fairly well, and cattle moderately, but in summer it is almost worthless. On fall range it is cropped to some extent.

Utah serviceberry (*A. utahensis*) occurs both as a low and high bush, $1\frac{1}{2}$ to 16 feet high, in foothills and on slopes of medium elevation, from Colorado and Utah to Nevada and New Mexico, and perhaps more widely (134, 99, 106, 107). The dry, pubescent fruit is yellowish to orange in color and of poor quality. The species is grazed moderately to heavily by cattle in early spring and is a good to excellent sheep and goat browse.

HAWTHORNS (CRATAEGUS SPP.)

Crataegus is an enormous genus, but only about a dozen species occur in the Western States, of which the two following are clearly the most important. The others furnish hardly more than a small quantity of local forage for domestic animals.

Black hawthorn (*Crataegus douglasii*, syn. *C. brevispina*), called also black haw, Douglas haw(thorn), and short-spined hawthorn, or western thorn apple (131), is a shrub or small tree, sometimes 35 feet high but mostly not over half that height. The large, blackish haws are sweetish, mealy, and edible but vary considerably in quality, those of some trees having a very good flavor while others are rather insipid. The exact range of the species is somewhat disputed, particularly toward the east, owing chiefly to divergencies of taxonomic opinion; but in general it may be stated as from British Columbia to California and possibly New Mexico, Wyoming, Minnesota, and Michigan—as a rule along or near streams and in bottom lands and swales, often in association with willows, cornel, chokecherry, and yew. Black hawthorn has been collected in the West at elevations of 900 to 5,500 feet, but generally in deep, rich soils only.

Black hawthorn, although one of the least thorny members of its genus, is often avoided by livestock and so is ranked by some as poor forage. The palatability of the foliage, however, varies from poor to fairly good, or sometimes good. In northern California it is occasionally one of the more important of the secondary browse species for cattle. Ingram notes that in central Oregon the tender shoots are sometimes cropped by cattle and sheep, and that in southwestern Oregon it is apparently relished by cattle in spite of its thorns. In the Wenatchee region of central Washington, however,

its palatability was found to be poor, even though it was browsed sparingly by sheep.

River hawthorn (*C. rivularis*) is very close to black hawthorn botanically and by some authors considered a variety of it. This is a Rocky Mountain species ranging along stream courses and in moist valley lands from Idaho to Nevada, New Mexico, and Wyoming, mostly between elevations of 3,000 (in the north) and 8,000 feet. It is not usually so tall as *C. douglasii* and has slender but short and relatively sparse spines. River hawthorn sometimes occurs in rather dense stands in the Wasatch Mountains, but as a rule is found as scattered individuals or in clumps. In some places it furnishes fair to fairly good cattle and sheep browse.

MOUNTAIN-ASHES (SORBUS SPP.)

About a dozen species of *Sorbus* occur in the northern hemisphere, seven or eight of these being found in the Western States. Although probably all these species have some local forage significance, only three are common enough to deserve detailed notice here: *S. occidentalis*, *S. scopulina*, and *S. sitchensis*. All three of these species, referred to indiscriminately as western mountain-ash, are constantly confused with each other, and with a fourth less common, *S. sambucifolia*, apparently a distinct species of Kamchatka and eastern Siberia. Because of this confusion, in which botanist and layman are alike involved, it is practically impossible to define with any accuracy the botanical range of any of these species. The following key will be found useful in attempts to identify the three species discussed below:

Plant low (mostly about 40 inches high, rarely as much as 9 feet tall).

Subalpine-alpine species. Leaflets dull above, serrate toothed toward the tip only. Fruit purplish, somewhat glaucous. *Additional characters:* Leaflets obtuse or rounded at apex. Inflorescence small and usually round-topped. Fruit often pear shaped-----*S. occidentalis*.

Plants taller (about 8 to 16 feet high). Montane, but not subalpine-alpine species. Leaflets shining above, serrate toothed their whole length or practically so. Fruit red, not glaucous.

Rocky Mountain and eastern species. Leaflets rather thickish, mostly of an elliptic or oblong lance shaped type, and two or three times as long as broad, acute (occasionally obtusish) at the tip. Fruit orange to scarlet and about one-third inch in diameter when mature. (Possibly only an eastern variety or form of *S. sitchensis*)-----*S. scopulina*.

Pacific species. Leaflets mostly thin, usually narrow lance shaped, about five or six times longer than broad, and long-tapered. Fruit coral-red, about one-fourth inch in diameter when mature-----*S. sitchensis*.

In marked distinction to a number of Old World *Sorbi*, the fruits of our native mountain-ashes are sour and inedible, and birds usually do not eat them unless other fruit is lacking.

Alpine mountain-ash (*S. occidentalis*), a fragrant-flowered shrub 2 to 9 feet high, is a high-mountain species, occurring near, at, or above timber line (Hudsonian and Arctic-Alpine zones), and ranging from Alaska and Yukon to western Montana and Oregon. Opinions vary somewhat as to its browse value, but there is no doubt that in some places it is important, although for only a portion of the grazing season. In parts of Idaho it is held to be good or very good browse on sheep and common-use range, at least toward the

close of the season; cattle will frequently not crop it until after frost. The bushes produce a large amount of accessible herbage. In some localities the species is quite susceptible to rust and this obviously greatly lessens its browse value. Flett (39) states that the Oregon jay, or "camp robber" (*Perisoreus obscurus*) and the Clark crow (*Nucifraga columbiana*) relish the fruits of this mountain-ash.

Greene mountain-ash (*S. scopulina*) is easily the commonest and often the sole species of the genus occurring in the Rocky Mountain region south of the Montana-Wyoming line. It has a very wide range, extending from Labrador to Alberta and possibly eastern Oregon south to Arizona, New Mexico, and in an indefinite line eastward to Michigan and Pennsylvania. The shrub is common in many parts of the range, mostly on sandy gravelly or rocky slopes and in canyons, between 4,500 and 8,500 feet elevation, often growing in association with snowberry, oak, elder, meadowrue, and sweet cicely. In general it is of most value late in the season, perhaps after frost, and appears to be of greatest browse utility in Utah and southern Idaho where it is often considered very good or excellent sheep feed. When in association with a good stand of highly palatable species, however, it is likely to be cropped but little.

Pacific mountain-ash (*S. sitchensis*),¹⁴ a smooth shrub (perhaps occasionally a small tree) 4 to 16 feet high, with coarse ascending branches, ranges from Alaska to Idaho, and California. It is a denizen of the (mostly high) mountains, chiefly in the yellow and lodgepole pine zones (Transition and Canadian) but sometimes extending up into the whitebark pine zone (Hudsonian) as well. Brewer and Watson (13) give its altitudinal distribution in the Sierra Nevada as 6,000 to 10,000 feet, though Jepson (67) indicates 7,000 to 9,000 as the usual limits. In Washington and Oregon the species usually occurs between 2,500 and 5,000 feet. It favors moist hillsides and sandy loam soils (frequently those with an acid reaction), often occurring in small thickets in open stands of shrubs and trees, a very frequent associate being redberry elder.

Pacific mountain-ash can hardly be regarded as more than fair browse, at least on properly grazed allotments, and apparently is rather more readily taken by sheep than cattle. It merits recognition here more from commonness than palatability to livestock.

OTHER GENERA

Oregon crab apple (*Malus fusca*, syn. *M. rivularis*) (116, 3) variously known as wild crab apple, Pacific apple, Oregon crab, or colloquially shortened to crab, is a small tree 15 to 40 feet high, or sometimes shrubby and about 6 to 10 feet high, mostly spiny-twigged and rather variable. It is probably the only native apple (*Malus*) found in the Western States. Reaching its best development in western Oregon and Washington, it ranges from the Aleutian archipelago down the Pacific coast to California, in rich bottom and valley lands, along streams, and in swamps, often forming im-

¹⁴ Authors preferring to merge the mountain-ashes in the pear genus call this species *Pyrus sitchensis*. Other botanists prefer to regard it as a variety of the eastern American mountain-ash, *Sorbus americana*.

penetrable thickets. The species is sometimes cultivated in the Eastern States as an ornamental.

Because of its spinescence and tendency to tangled growth Oregon crab apple is not a first-class browse plant; moreover, it is often inaccessible or too tall for grazing. The foliage, however, is palatable and in some places it ranks as a fair cattle forage. The mostly tawny, oblong, edible fruits have an agreeably acid flavor.

Squaw-apple (*Peraphyllum ramosissimum*) (pl. 4, C) is a monotypic genus, consisting only of this much-branched, rigid-twigged shrub, 2 to 6 feet high. It is of an almost innumerable series of western shrubs called buckbrush, and is often known locally as wild apple or wild peach, and in Oregon as Oregon apple. The characteristic fasciculation of the leaves at the twig ends is alluded to in the generic name, *Peraphyllum*.

The species ranges from eastern California to eastern Oregon, western Wyoming, northwestern New Mexico, and Nevada. Squaw-apple is most characteristic of the juniper and lower yellow pine types but occurs both below and above those belts, and has an altitudinal distribution of 3,000 feet in Oregon to 8,500 to 9,000 feet towards the southern limits of its growth. It mainly inhabits dry foothill and mountain slopes, especially in sandy loam soils. In certain localities in Utah it is the predominating species and elsewhere is very common. The flowers appear with the leaves usually between May 10 and June 10, the fruits usually ripening in July.

Considerable diversity of opinion exists regarding the browse value of squaw-apple. In western Colorado it is usually looked on as poor, sometimes worthless, and, at best, fair. In the Manti region of central Utah Chapline found it to be almost worthless. In eastern Oregon it is commonly considered fair to moderately good sheep and cattle browse in the spring and fall but a negligible quantity on summer range. In the Dixie Forest region of southwestern Utah (where, however, there is much local overgrazing) it has been ranked as a valuable browse. In the lava-bed country of northeastern California, where the species is often very abundant, it has been termed good sheep browse but worthless on horse range.

ALMOND FAMILY (AMYGDALACEAE)

CHOKECHERRIES, CHERRIES, AND PLUMS (PRUNUS SPP.)

The genus *Prunus* is a very large one, but is almost exclusively confined to the Northern Hemisphere. Taking a fairly conservative view of the genus and including in it the cherries (*Cerasus* spp.), the chokecherries (*Padus* spp.), and the laurel-cherries, or cherry-laurels (*Laurocerasus* spp.), but omitting the peach-almond group (*Amygdalus* and *Emplectocladus* spp.), it consists of at least 125 species. Probably 21 or more native species occur in the Eastern States and about 19 in various parts of the West, excluding 2 eastern species of wide range. A number of Old World species are in common cultivation in the United States, for example, apricot (*P. armeniaca*), common plum (*P. domestica*), mazzard (*P. avium*), frequently called sweet cherry, and sour cherry (*P. cerasus*). Some of these have a tendency to escape and become locally naturalized.

The browse value of several of the native western plums and "wild cherries" on sheep and cattle range is considerable, perhaps especially so on sheep allotments and in late summer and fall. The species, however, do not as a rule resist overgrazing well. Livestock are most apt to take the season's twigs, and repeated cropping of this sort so rapidly devitalizes the bushes that sheep and goat killed cherry and plum thickets are not an uncommon sight wherever there has been overstocking or other mismanagement. The plum characteristic of stooling out from the base or by root suckers is conducive under too close utilization to sapping the vitality of the root system.

The cherries, chokecherries, and laurel-cherries, or cherry-laurels, have a more or less well-marked tendency (doubtless associated with the often pronounced almondlike odor of the herbage) to develop hydrocyanic (prussic) acid (HCN), involving the poisoning of livestock (16, 17, 19, 44, 53, 68, 76, 77, 81, 95). Long points out that Schrader, as long ago as 1803, made a chemical study of cherry-laurel poisoning. The statement is frequently made that cherry leaves are poisonous only when in a wilted condition, and that they are practically innocuous when fresh, but experiments have demonstrated that this is largely a fallacy. Howard (90) has found, in the case of the eastern chokecherries that the largest, most tender, and most succulent leaves develop the greatest amount of hydrocyanic acid and that the dry, woody leaves of mature plants yield so little as to render them nearly harmless. He considers, therefore, the greatest danger to be from the vigorous, succulent leaves of young shoots (which cattle and sheep are probably most liable to eat). Such leaves when wilted are also poisonous and even when dried are still to be regarded with suspicion. Fortunately the most virulent part of the plant, the seed pit, is not eaten by livestock or, if swallowed with the harmless fleshy part of the fruit, passes unassimilated out of the digestive tract.

Despite the numerous notes in literature there is still much to be learned about the details of western chokecherry and cherry-laurel poisoning, such as the quantity of leafage (for various species) necessary for a lethal dose, and the time or times of greatest danger. It is evidently the part of safety not to graze cherry patches too early or at other times when young, vigorous shoots and leaves are much in evidence, not to drive sheep when hungry along trails extensively lined with these species, nor to permit livestock to gorge themselves on cherry alone without a liberal admixture of other feed.

Birds, as well as rodents and some other mammals, exhibit a marked fondness for the fruits of the native species of *Prunus* and are largely responsible for the dissemination of these plants, which are, therefore, species of importance in the study of indigenous wild life and its conservation.

Black chokecherry (*Prunus melanocarpa*, syns. *Cerasus demissa melanocarpa*, *Padus melanocarpa*, *Prunus demissa melanocarpa*), known locally as cherry, chokecherry, and (black) western chokecherry (131), is a shrub (or small tree mostly shrubby and branching at or near the base) varying when fully grown from about 20 inches to a known but very unusual height of 30 feet. The spheri-

cal, rather small fruits are dark purple to black, sweet in flavor, but slightly astringent.

The species ranges from North Dakota to British Columbia, California, New Mexico, and Kansas. It often grows in dense patches or thickets, but sometimes alone or scatteringly; it occurs on dry hillsides, in bottom lands, along or near streams, in canyons and draws, in moist, rich soil, and in dry, rocky, and sterile soils. Frequent associates are western yellow pine, serviceberry, aspen, maple, currants, sagebrush, wild plum, hawthorn, oak brush, ninebark, buffaloberry, rose, and elder. It is found in open timber and in weed types, but is most characteristically a component of browse types. The altitudinal distribution varies from 1,500 or 2,000 feet at the easterly limits of its range and in the Northwest up to at least 9,000 feet in the Colorado Rockies. In Utah, southern Idaho, and Nevada it occurs mostly between about 5,000 and 7,500 feet. The flowers appear from May to July and the fruit ripens and falls from about August 1 on.

As a range browse black chokecherry varies from poor to good. It is usually of greatest value late but sometimes also very early in the grazing season. Although it grows in thickets, these are generally open enough to be accessible to grazing animals and the abundance, size, and relatively good palatability of the species make it important on many ranges. In general this chokecherry is browsed on sheep and cattle ranges in Montana and Nevada; in Utah and Idaho it is occasionally important on sheep ranges; in Colorado, Wyoming, and the Northwest it is commonly considered poor forage. Analysis of the species indicates a remarkably high protein content (143, p. 39). Livestock poisoning has sometimes resulted from browsing this species (44), in common with others of the genus.

Western chokecherry (*Prunus demissa*),¹⁵ of which *P. melanocarpa* is by many regarded as a variety, occurs from British Columbia to western Montana and California. Although ordinarily a shrub or small tree, heights of 50 feet have been recorded for this species. It is found alike in rich moist loams and in dry rocky localities, often growing with serviceberry, hawthorns, ceanothi, lupines, currants, and geranium. Its altitudinal distribution is from sea level to 7,000 feet; in Washington, Oregon, and northern California it is most frequently encountered between about 1,500 and 5,000 feet. Western chokecherry is browsed only lightly to moderately on most ranges by sheep and cattle but in times of relative food scarcity, as for example in the fall, it is sometimes extensively cropped, especially by sheep. Fleming and associates have investigated cases of sheep poisoning due to this species (38, 36). They find that on dry range poisoning is often delayed until the sheep are able to drink, when the hydrocyanic acid is more readily released; that poisoning is usually a result of dry or overgrazed range, and that the leaves lose their poisonous properties and become more palatable in the late summer, the species being harmless in the fall.

Southwestern black cherry (*P. virens*), sometimes known as evergreen chokecherry, a southwestern species ranging from southern

¹⁵ Some authors prefer to follow Sargent (116, p. 574) in regarding this as a variety of the common, eastern, or Virginia chokecherry, calling it *Prunus virginiana demissa*. *Cerasus demissa* and *Padus demissa* are synonyms.

Arizona to western Texas and south into Mexico, with thick, more or less persistent leaves, is largely confined to moist mountain canyon bottoms where, if sufficiently abundant and accessible, it furnishes fair to good winter browse for cattle, sheep, and goats.

Bitter cherry (*P. emarginata*), known also as bird cherry, blunt-leaf cherry, narrowleaf cherry, pin cherry, and quinine cherry, is perhaps the commonest and best known of the native western true cherries. It occurs both as a shrub and as a small tree, ranging from British Columbia to Montana, Arizona, and California, at elevations varying from sea level to 8,000 feet. It is often common and abundant and reaches its best development in rich, moist alluvial soils, but occurs on dry hillsides also. The species is frequently associated with snowbrush, hazel, oaks, garrya, manzanita, bracken, wild peas, lupines, and vagnera; it grows in the open and in partial shade, but is especially characteristic of open browse (brush) types. The forage value of bitter cherry varies from worthless to good, usually being of most value toward the end of the season. It is frequently claimed to be poisonous, but probably because it has been confused with the chokecherries.

Plumleaf cherry (*P. prunifolia*, syns. *Cerasus mollis*, *C. prunifolia*, *P. emarginata mollis*, *P. emarginata villosa*) has a range and forage value similar to that of bitter cherry.

Pin cherry (*P. pennsylvanica*) of the East, also called bird cherry, pigeon cherry, and wild red cherry, extends westward as far as British Columbia and Colorado, but apparently has little range significance in the West. In the East it is sometimes involved in cherry poisoning (90). Its small, sour fruits are much sought after by birds.

Pacific plum (*P. subcordata*), also known as Sierra plum and Klamath plum, a species ranging from California to central Oregon and possibly invading Idaho also (107), and locally prized for its fruit, is perhaps the best known of the several native western plums. It occurs as a thorny-twiggged chaparral shrub on dry slopes, often in association with manzanita, wedgeleaf hornbrush, and chokecherry; and as a small tree in rich bottomlands. The altitudinal variation is mostly between 2,500 and 4,500 feet. In northern California it is frequently replaced by the variety *P. subcordata kelloggii*. Pacific plum is often heavily grazed by sheep and, where overgrazing takes place, is not infrequently killed out despite its thorny character and usual thicketlike growth.

PEACHBRUSH (EMPLECTOCLADUS SPP.)

Peachbrush is known also as wild peach (brush) and wild almond. It is considered by some botanists as indistinguishable from the peach-almond genus (*Amygdalus*). Some other botanists go a step further and merge both *Amygdalus* and *Emplectocladus* in the plum-cherry genus (*Prunus*). It is, of course, a moot question whether the three are distinct generically.

About five species of peachbrush occur in the West. They are low, diffusely branched shrubs, with small and mostly rather narrow leaves; the twigs are frequently spiny to thorny. These bushes grow on dry, warm foothills of the Southwest and are local in distribution; their foliage is rather scant but moderately palatable, and their low

sprawling growth, open stand, and clustered leaf habit are conducive to full utilization. Altogether, while distinctively secondary species, they furnish considerable browse in certain semidesert localities.

Anderson peachbrush (*Emplectocladus andersonii*, syns. *Amygdalus andersonii*, *Prunus andersonii*), called also Anderson almond, Nevada wild almond, and wild peach (brush), is probably the nearest of the peachbrush species to the cultivated peach. This is a thorny, spreading shrub 1 to 6 feet high, usually flowering and leafing from April to June. Anderson peachbrush occurs in eastern California and western Nevada, in coarse sandy, gravelly, or rocky soils, often over disintegrating granite, mainly between elevations of 5,000 and 6,500 feet, and frequently in canyons. As it is often abundant, has perhaps the largest leaves of its genus or group (except possibly the west-Texan *E. minutiflorus*), and is usually accessible, it is probably the most valuable range member of its alliance. All classes of livestock crop the foliage, which is largest and most available in the spring or after rains in the latter part of the season. The species ranks as fair to good sheep and goat browse and only slightly inferior for cattle during the periods mentioned.

Torrey wild almond (*E. fasciculatus*, syns. *Prunus fasciculatus*, *Amygdalus fasciculatus*), a species somewhat similar to Anderson peachbrush, and known also as (California) desert almond and desert plum, occurs in the region of Lower California, southern California, Arizona, and southern Utah. This is a bush, mostly 2 to 4 (rarely 7 or 8) feet high, and is often encountered in canyons in the piñon-juniper belt, growing among rocks. Its flowers and leaves appear from March to May, and it furnishes a scant amount of provender for goats and sheep. It is one of the relatively few western shrubs that are dioecious, i. e., with distinct sexes, only the pistillate plants producing fruit. *E. fremontii* (syns. *P. fremontii*, *Amygdalus fremontii*) of the San Diego region, southern California, and northern Lower California, *E. glandulosus* (syn. *P. glandulosa*) of Texas, and *E. minutiflorus* (syn. *P. minutiflora*) of western Texas and Chihuahua, Mexico (the two last named diminutive bushes, only 1 or 2 feet high), are similar species, furnishing a small amount of local goat and sheep forage.

Osoberry (*Osmaronia cerasiformis*, syn. *Nuttallia cerasiformis*), often called Indian plum, is an ornamental shrub (4), or rarely a small tree, 2 to 15 feet high, with deciduous leaves 2 to 4 inches long having a peculiar, rather disagreeable odor when first appearing. Essentially a Pacific species, it ranges from British Columbia to California, mainly in the coastal region.

The relationships of osoberry, its general appearance, and its large, delicate leaves create the impression that livestock would probably browse it; but information on its use is scant. It is reported as unpalatable to livestock (early in the season at least) in the Mount Hood region of northwestern Oregon. The species has a significance in wild-life control because of its fruits, in the quality and flavor of which there is apparently considerable variation. D. C. Ingram reports the fruit from the Umpqua National Forest region as sweet and palatable. Greene (46, p. 51), on the other hand, states that about San Francisco the fruit has a bitter taste but that it is eaten greedily by birds and mammals.

MIMOSA FAMILY (MIMOSACEAE)

ACACIAS (ACACIA SPP.)

The genus *Acacia* is a huge one, of at least 300 species, and it is of most importance in Australia and Africa. It is a highly valuable timber group in Australia, and a number of the Australian acacias are now being cultivated in this country, California especially. The bark and pods of all acacias are more or less astringent and many species are utilized on this account in tanning.

About 16 species of acacia are native to the West, nearly all of which are wholly confined to the region from western Texas to southern California and south into Mexico and Lower California. Probably all have some forage value though none of the others equal catclaw in this respect and some are quite inferior.

Catclaw (*Acacia greggii*)¹³ (fig. 16, D-G), also called catclaw acacia, cat's claw, devil's claw, Gregg's acacia, and paradise flower, varies in size and form from a very prickly bush to a tall shrub or small tree. It is a southwestern species, ranging from western Texas to southern Nevada, northern Lower California, and northern Chihuahua, Mexico. It is a typical desert or semidesert species, very drought-resistant (121), often occurring in dry valleys and ravines, and on sandy gravelly arid mesas, usually in considerable abundance. It is especially characteristic of the creosote bush (Covillea) belt, or Lower Sonoran Zone, frequently in association with mesquite (*Prosopis*). The dense cylindrical spikes of fragrant, yellow flowers appear as a rule in May and June, while the brown, contorted pods mature mainly from July to September.

Because of its abundance, vigor, and ability to stand heavy grazing and the fair palatability of its foliage catclaw furnishes considerable feed, especially on depleted desert ranges. Where there is a good stand of grass, it plays but a small part in the range forage except in drought. The pods are of inferior palatability. Catclaw has the desirable habit of greening out in the spring before the new leaves appear, and these relatively succulent green twigs are much relished by cattle. Since the plant is leguminous the percentage of protein or nitrogenous matter in the edible plant tissues is presumably high.

Catclaw, when of tree habit, is valued on the range for the shade it produces, a matter of especial importance in arid places. Goldman (45) notes that catclaw affords by its shade and thorny protection a "favorite hiding place for jack rabbits and other mammals"; it is also useful as a bee plant (75) and for shellac (118, 121).

OTHER SPECIES

Mescat acacia, often known as mescat (*A. constricta*), a common spiny southwestern bush (fig. 16, A-C), is considered inferior to almost worthless forage, except that the pods are often taken. Fernleaf acacia, sometimes called dwarf acacia (*A. filicioides*) (fig. 16, H, I) and Lemmon acacia (*A. lemmoni*) are small shrubs, 10

¹³ The original American catclaw is *Pithecollobium unguis-cati* (L.) Mart. (= *Mimosa unguis-cati* L. and *Zygia unguis-cati* (L.) Sudworth) of Florida, the West Indies, Mexico, and South America. The American Joint Committee on Horticultural Nomenclature (3) recommends standardization of the name blackbead for *P. unguis-cati*.

Acacia constricta

FIGURE 16.—Three common acacias which furnish more or less livestock feed in the Southwest: A-C, Mescal acacia (*Acacia constricta*); D-G, catclaw (*A. greggii*); H, I, fernleaf acacia (*A. filicioides*)

inches to 5 feet high; they are browsed somewhat and their pods, at least in parts of central and southern Arizona, seem to be much relished by both cattle and horses. Netvein acacia (*A. reticulata*), locally known as dwarf(ed) mesquite, is occasionally abundant at

altitudes of 4,500 to 7,000 feet in the mountains of southeastern Arizona, being esteemed there as yearlong cattle browse; however, it is probably more palatable in spring, fall, and winter than in summer.

SILK FLOWERS AND FALSE-MESQUITE (*CALLIANDRA* SPP.)

The genus *Calliandra* is a large one, confined to the Americas, mainly in the Tropics. It is very closely related, however, to the Old World (Mediterranean) genus *Albizzia*, to which belong the familiar ornamental silktree and mesenna, whose bark is a specific for tapeworm. The medicinal (antiperiodic) panbotano bark of Mexico is derived from *C. houstoni*; saponin, according to Greshoff (95) occurs in the same species, but there appears to be no ground for regarding the genus with suspicion from the stock-grazer's viewpoint. Several of the species are under cultivation as ornamentals under the generic name silk flower, and a number yield an astringent gum.

False-mesquite (*C. eriophylla*) is a dwarfed, more or less prostrate shrub (fig. 17), known also as bastard mesquite, false catclaw, and occasionally hairy-leaf calliandra, occurring from western Texas to central Arizona and southward practically throughout Mexico. Where it is protected it is sometimes 2 feet tall and rather erect, but more commonly is but 3 to 12 inches high. It is a common feature of the landscape on many foothills of the Southwest between about 3,000 and 4,000 feet, growing in warm open sunny situations. It is especially characteristic of sandy gravels of granitic origin, and is associated with such plants as alfileria, catclaw, curly mesquite grass, and the lower-range grama species. The showy purplish flowers are produced from February to April. Seed is ripened and disseminated from May to August.

False-mesquite is a very good browse plant within its range, where it is usually plentiful. Its delicate but copious foliage and the more tender of its twigs are highly relished by both sheep and cattle, making it an important and valuable species, particularly in the spring. In southeastern Arizona the species is regarded as one of the most important forage plants.

Chemical analyses by the Bureau of Chemistry and Soils of leaves and young twigs of this species from the Prescott National Forest in Arizona show crude fiber somewhat high but also a high protein percentage:

	Per cent
Moisture.....	7. 86
Ash	6. 02
Ether extract.....	2. 50
Protein.....	14. 00
Crude fiber.....	15. 46
Nitrogen-free extract	54. 16
Total.....	100. 00

MESQUITES (*PROSOPIS* SPP.)

Prosopis is a (largely African) genus of about 17 species, occurring in warm, mostly dry, subtropical or tropical climates.



FIGURE 17.—False-mesquite (*Calliandra eriophylla*), palatable southwestern browse

Honey mesquite (*Prosopis glandulosa*,¹⁷ syn. *P. juliflora glandulosa*) (fig. 18) is known also as glandular mesquite, prairie mesquite, or simply mesquite. This typically many-branched shrub is about

¹⁷ Many botanists regard this as a variety of the common mesquite, *Prosopis juliflora*, which is typical of Jamaica.

10 feet tall, but often becomes a small tree 15 or 20 feet tall, or, again, may have but little development above ground.

Honey mesquite occurs from southern Kansas and eastern Texas to southern and Lower California and south into Mexico. Standley

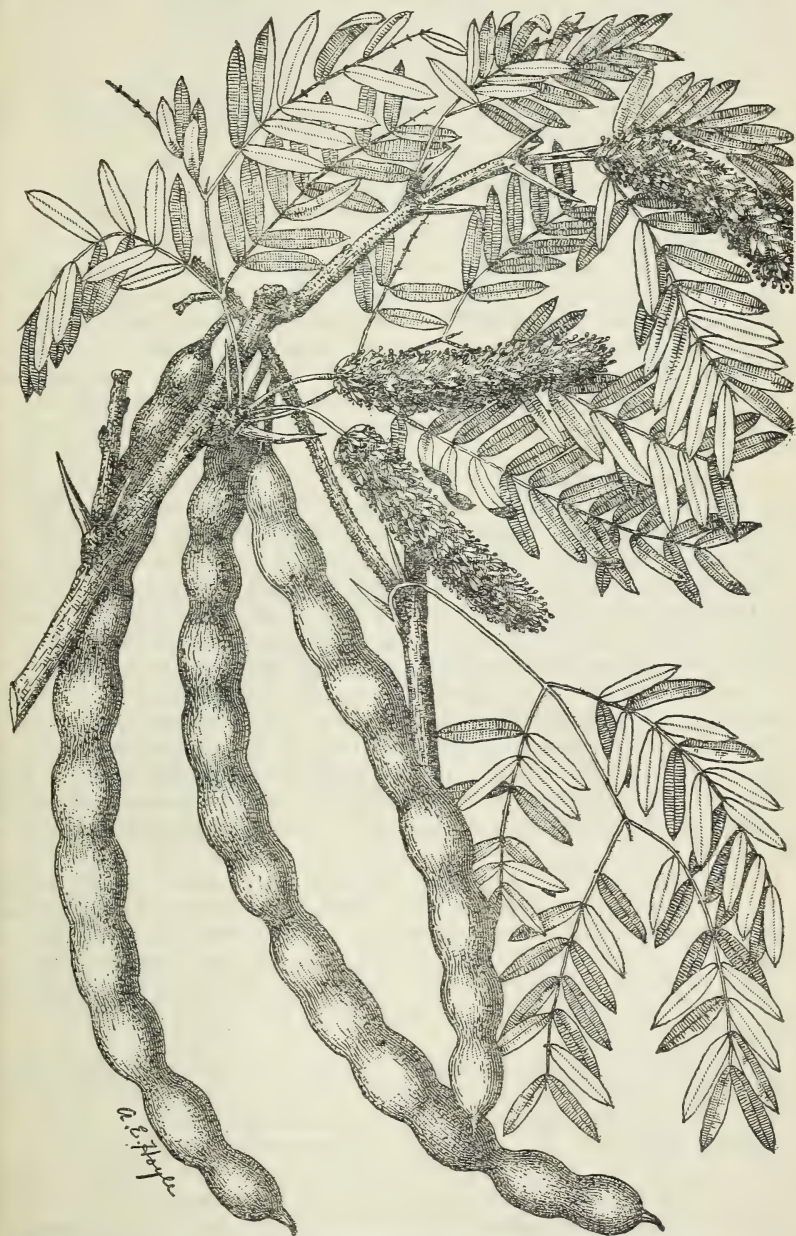


FIGURE 18.—Honey mesquite (*Prosopis glandulosa*), an aggressive tree or bush of arid sites in the Southwest, of forage value chiefly because of its highly palatable and nutritious pods

(126) intimates that it also occurs in Peru and Argentina. The shrub inhabits dry, sandy, or gravelly plains, canyons, and hillsides between about 2,500 and 5,000 feet, the tops of many low broad hills, and larger areas of sand hills. The flowers appear from April to June and the pods reach maturity in September and October; not infrequently, however, flowers are again produced in early winter resulting in an early (about July) crop of pods.

The most valuable forage feature of this species is the pod or bean, 4 to 8 inches long when ripe, and sweet and pulpy within, very rich in protein (40, 141), and exceptionally palatable and nutritious. All kinds of domestic livestock, horses, cattle, sheep, goats, and swine, as well as numerous native mammals, seek these pods. They are also a staple food among many of the Indians and Mexicans.

Honey mesquite "greens out" in the spring before the leaves appear, and these green twigs are readily grazed by livestock at that time. In drought years the mature twigs and leaves are taken fairly well by all classes of livestock before summer rains stimulate the growth of other forage; otherwise these parts are seldom taken by cattle unless the range as a whole is overgrazed or in fall and winter when there is marked scarcity of other feed. However, the leaves fall early and hence are often not available for late summer use.

It is all but impossible to kill honey mesquite and its close relative, *Prosopis velutina*, by overgrazing. The fact that many of the seeds pass out of the digestive tract undigested and viable accounts largely for the persistent spread of the plant. The plant is also maintained in spite of overgrazing by reason of its phenomenal root development, which perhaps exceeds that of any other observed plant species. The roots, in addition to a considerable lateral spread, have vertical ground penetration that in many instances reaches 30 feet, and has been reported to reach 60 feet below the surface. The fact that the distribution of honey mesquite is spreading, owing to its natural aggressiveness and the fact that it resists prolonged range overgrazing at the expense of its competitors, have caused some writers to deprecate mesquite as forage. This is especially so on the eastern borders of the species' range, where it is taking possession of grasslands.

Honey mesquite has a number of uses in addition to its forage value. The root wood, being very hard and having little sapwood, makes first-class coals, and in many localities is excavated with great labor as the chief source of fuel. The aerial trunks of the tree are in great demand for fence posts. Also, a gum similar in properties and value to gum arabic is sometimes extracted in commercial quantities.

The species is a famous honey plant, the nectar of the flowers making an exceptionally high-grade honey. A popular beverage, atole, is made from the cooked and strained beans (59).

Velvet mesquite (*P. velutina*) and **common mesquite** (*P. juliflora*) are the only other species occurring in the United States, both having forage value and properties very similar to those of *P. glandulosa*. *P. velutina* (pl. 5, B) occurs in Arizona, Sonora, and Lower California. It is regarded by many botanists as a variety of *P. juliflora*, being called *P. juliflora velutina*. *P. juli-*

flora is typical of Jamaica and, according to some authorities, is really native to Mexico and South America, its range now extending almost around the world, owing to introduction. Its exact range in the southern or southeastern United States depends in part on one's viewpoint respecting its relation to *P. glandulosa* and *velutina*. *P. juliflora* long ago became naturalized in the Philippines and Hawaii, and in the latter locality is said to have spread (73) rapidly and become one of the most useful tree species, under the name of algaroba, misapplied to mesquite because of its superficial similarity to the Old World carob (*Ceratonia siliqua*).

SCREWBEANS (*STROMBOCARPA* SPP.)

Screwbean (*Strombocarpa odorata*, syns. *Prosopis odorata*, *P. pubescens*, *Strombocarpa pubescens*), or screwbean mesquite (131), frequently called by the Mexican name tornillo (fig. 19), is a shrub or small tree, occasionally 30 feet high and about a foot in diameter, with stout whitish stipular spines and flaky bark. The species ranges from western Texas to southern Nevada, northern Lower California, and Chihuahua. It is characteristic of canyons and river valleys, reaching its best development in low, rich, sandy, or gravelly bottom lands, but is also found as a bush in the foothills at higher elevations, up to at least 4,500 feet; frequent associates are mesquite and hackberry. The small, yellowish, fragrant flowers first appear in early spring, and often several successive crops of pods ripen during the summer months, dropping to the ground in fall.

As in mesquite, the most valuable forage is the thick, sweet, pulpy, yellowish, spirally twisted pods of the screwbean, which are remarkably high in sugars and proteins and are both an energizing and fattening feed. These beans are often produced in great abundance and all classes of livestock, as well as native herbivores, eat them. Indians and Mexicans frequently eat the pods raw and sometimes grind them into a sort of meal for baking, as they do the mesquite pods. Screwbean "greens out" in spring, and from about April to June the tender season's twigs and the young leaves are relished by all classes of livestock that can reach them. The mature foliage is more apt to be taken in the fall. Screwbean has a tendency to grow in dense thickets, which frequently occupy large areas, and this habit militates against its full utilization. The very hard wood is used extensively for fuel and fence posts.

Dwarf screwbean (*S. cinerascens*), sometimes called ballhead screwbean, from the headlike (capitate) inflorescence, occurs in southwestern Texas, ranging southward into Mexico. Its browse value is probably somewhat similar to that of *S. odorata*, but its very small size (mostly 6 to 12 inches high) and diminutive foliage (the leaflets only one-sixteenth to one-eighth of an inch long), while conducive to full utilization, would provide far less forage than does the common screwbean.

MIMOSA (*MIMOSA* SPP.)

Mimosa is a very large genus, consisting of at least 300 species, widely distributed in the sub-Tropics and Tropics; its members are shrubs, small trees, woody climbers, or rarely herbs. About 20



FIGURE 19.—Screwbean (*Strombocarpa odorata*). Its peculiar corkscrewlike pods are often produced in great abundance and are relished by livestock

species are native to this country, in the region from Texas to Arizona, all but one or two of which are shrubby or arborescent. A number of the species have considerable forage utility, despite their (usually) curved prickly or spiny stems. They are frequently

called catclaw and cat's claw and, by Mexicans, gatuño and uña de gato.

At least three shrubby mimosas are common and abundant on many southwestern ranges. All are species of warm, dry, gravelly, or rocky sites in canyons and foothills, between approximate elevations of 3,000 and 6,000 feet, from western Texas to southern Arizona and south into Mexico (except that *Mimosa fragrans* has not as yet been collected in Arizona or Mexico and may not occur there), and all have some range significance.

Catclaw mimosa (*M. biuncifera*), often called wait-a-minute bush or paired-thorn mimosa, is a loose thorny bush, 1 to 3 feet or occasionally as much as 6½ feet high. The species is so common and abundant as to derive value from sheer quantity; its palatability is seriously impaired by its dense prickliness (especially below), and its accessibility by its tangled form of growth. However, it is sometimes ranked as fairly good feed, the younger and less prickly growth being taken, and in winter and spring (and during summer and fall also in periods of prolonged drought) it is an important cattle browse in southern Arizona and New Mexico. Despite the frequent spininess of those parts, livestock often devour the pods.

Velvetpod mimosa (*M. dysocarpa*) has relatively rather large leaves and densely velvety woolly pods; often only the season's growth has thorns. As a rule this species is held to be fair cattle and horse feed, and is sometimes of considerable importance, although neither the foliage nor pods equal those of *biuncifera* or *fragrans* in palatability. It is grazed by cattle for a brief season during dry periods, especially in the spring months when grass is scarce or wanting; it is also cropped a little during the summer.

Fragrant mimosa (*M. fragrans*) is a low, stout, spreading shrub with smooth foliage. It is one of the most palatable members of the genus, but when closely used is apt to be badly broken down because of lack of flexibility. The species is one of considerable importance on many goat, sheep, and cattle ranges, both the herbage and pods being readily taken.

CASSIA FAMILY (CAESALPINACEAE)

This family is regarded by some (especially older) botanists as a subfamily or tribe of the legume (pea) family.

PARKINSONIA SPP.

Parkinsonia is a genus of two species, one native to warmer portions of North America and South America, but now widely distributed by cultivation, and one isolated species in south Africa. They are spiny shrubs or small desert or semidesert trees with small leaflets or, in drought, often leafless.

Jerusalem-thorn (*P. aculeata*), known also as girasol-thorn, horsebean (131),¹⁸ bagote, paloverde, and retama, ranges from Florida to California and south into South America, and is frequently cultivated in border towns. Economically its status is practically identical with that of the closely related paloverdes (*Cercidium* spp.), but the larger leaves make it somewhat superior as browse.

¹⁸ True horsebean is a variety of the cultivated Old World legume *Vicia faba* (syn. *Faba vulgaris*), grown for livestock. Retama is best restricted to members of that genus.

PALOVERDES (CERCIDIUM SPP.)

*Cercidium*¹⁹ is a semitropical or tropical American xerophytic genus of about 11 species, the Spanish-Mexican name referring to the smooth, bright (sometimes yellowish or brownish) green bark of most of the species. In periods of prolonged drought or other feed shortage paloverdes assume some local importance as emergency forage. Their young branches and scanty foliage are ordinarily eaten but slightly by livestock in summer, but in the spring and after heavy rains or in the more moist situations at the eastern edge of their range the leaves become larger, more abundant, and more succulent, thus enhancing their forage value. The pods are nutritious and fairly palatable to livestock and are sometimes ground into meal for human consumption. For the traveler in the desert paloverdes provide both fuel, and fodder for his beasts of burden. The genus is also valued for erosion control in gulleys, as honey plants, and as food for birds. Three species are common in the Southwest.

Border paloverde (*C. floridum*, syns. *Parkinsonia florida*, *P. torreyana*, *C. torreyanum*), known also as Texas paloverde (131), ranges from southwestern Texas to southern California and south into Lower California and other parts of adjacent Mexico.

Littleleaf paloverde (*C. microphyllum*, syn. *P. microphylla*), locally known as palo Christo, interesting comments on which are given by Kunzé (75) and Hornaday (64), is found in southern California, Lower California, southern Arizona, and Sonora.

Texas paloverde, or dwarf paloverde (*C. texanum*, syn. *P. texana*), a rigid bush 2 to 5 feet high, with only one or two pairs of leaflets, often forms dense thickets in the Rio Grande region of southwestern Texas.

REDBUDS (CERCIS SPP.)

Redbuds, sometimes called Judas-trees, are represented in the West by three species, but their leathery foliage ordinarily seems unacceptable to livestock. California redbud (*C. occidentalis*) is cultivated as an ornamental.

RATANY FAMILY (KRAMERIACEAE)

RATANIES (KRAMERIA SPP.)

Ratany is the only genus of its family and consists of about 20 (North and South) American species, of which about five or perhaps six occur in the United States. The genus is of pharmaceutical interest as the source of rhatany root (*Krameria radix*), which is a powerful astringent, useful in the treatment of chronic diarrhea

¹⁹ *Cercidium* is regarded by many botanists as a synonym of *Parkinsonia*, but even those who recognize both genera usually place in *Parkinsonia* some species which would be better placed in *Cercidium*. As the nomenclature of these plants is so confused in literature, it seems desirable to give a key to the two genera, based, to a large extent, on I. M. Johnston's treatment (69):

Leaves elongated; leaflets numerous (20 to 30 pairs, or even more), rather wide spaced; rachis (main leaf axis, or petiole) very short, from the axil of a large spine, ending in a spiny tip; rachillae (axes of the pinnae, or two main leaf divisions) long, flattened, winged, and leaflike; sharp at the tip; flowers in an elongated raceme; calyx lobes strongly imbricated (i. e., edges overlapping) in bud. Pods terete (i. e., cylindrical, or nearly so), torose (conspicuously constricted between the seeds).—*Parkinsonia*.
Leaves short; leaflets few, mostly 2 to 6 or occasionally 12 pairs, rather close together; rachis (main leaf axis), or petiole, relatively long, not spiny or else with a short prickle at the base; rachillae (axes of the two main leaf divisions) short, rounded, neither winged nor leaflike; flowers in a short corymb; calyx lobes valvate or induplicate valvate (not overlapping) in bud. Pods either flattened or rounded (terete), either constricted between the seeds (torose) or not.-----*Cercidium*.



F41722A F40993A

A, New growth of bitterbrush (*Purshia*), together with snowberry (*Symphoricarpos*), intermixed with needlegrass, wheatgrass, and weeds coming in on a browse range in western yellow pine type, formerly overgrazed, Dixie National Forest, Utah; B, velvet mesquite (*Prosopis velutina*), in the Santa Rita Range Reserve, southeastern Arizona. This tree is characteristic of the size this species attains in favorable habitats of the region



F187548

Gorse (*Ulex europaeus*), an Old World shrub, established and sometimes becoming a pasture and range pest on the east and west coasts of the United States

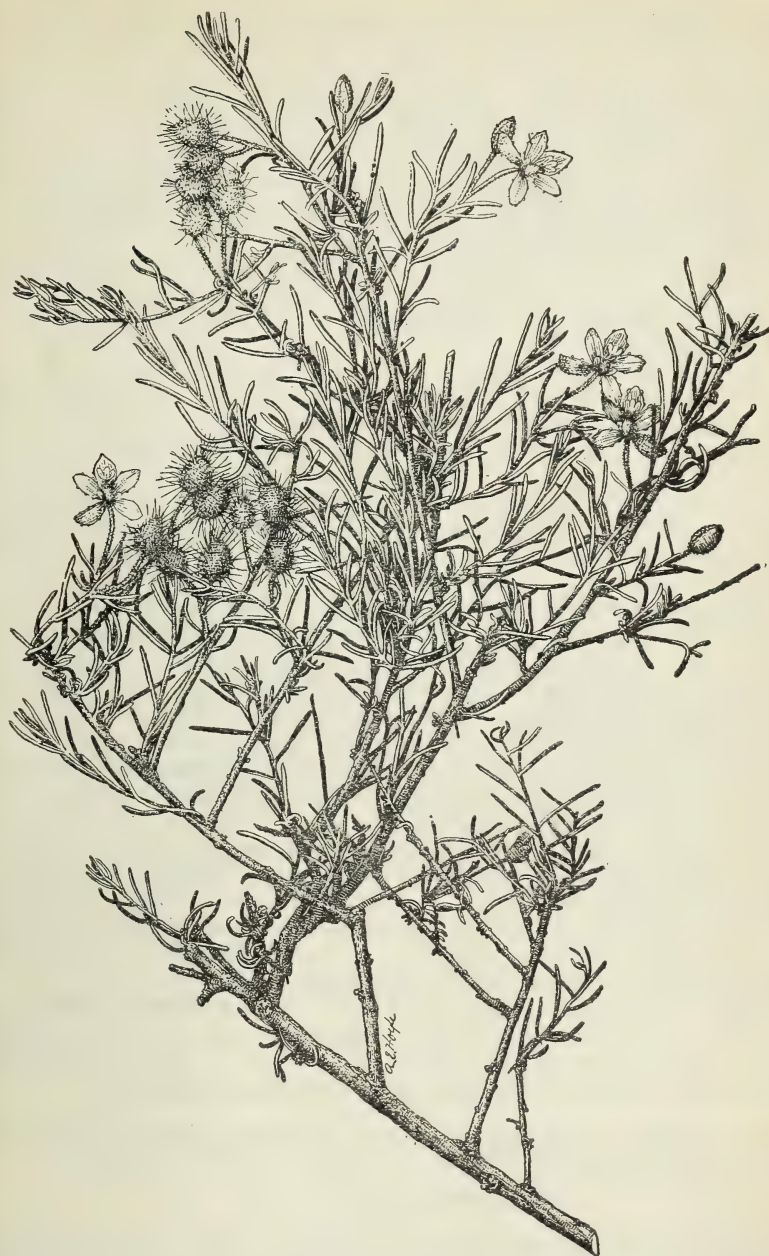


FIGURE 20.—Range ratany (*Krameria glandulosa*), a valuable southwestern browse species

and other disorders. The Mexicans use several of the ratanies in dyeing wool and hides yellowish, brownish, or reddish, and the roots have been employed in the manufacture of ink.

27259°—31—6

Range ratany (*K. glandulosa*), locally known as heart-nut, is a low, densely, and diffusely branched shrub (fig. 20), 8 to 24 inches high, with numerous small leaves, rather handsome, purplish flowers, and rounded spiny pods. The species ranges from western Texas to southern Utah, southern California, and south into Mexico. It is largely a foothill plant, with an altitudinal distribution of 2,000 to 4,500 feet, occurring typically on dry rocky mesas accompanied by various lower range gramas, three-awns, eriogonums, gilies, lotuses, and lupines. Although common and abundant it occurs usually as scattered individuals. Some years it has two flowering periods, in the spring (April and May) and in late summer or early fall (August and September), the seed ripening within about a month or six weeks after flowering.

Range ratany is a valuable and well-relished forage plant for all classes of livestock, and is often closely eaten down on cattle ranges. The branches are somewhat brittle and trail along the ground more or less, so that intensive grazing is liable to be very injurious to the species. On the other hand, the delicately spiny and burlike fruits are well adapted to dissemination by animals, which also probably help to plant the seeds by trampling and rolling, and there is little question that grazing assists in spreading and maintaining the species.

Trailing ratany (*K. secundiflora*), also called sand bur and Texas ratany, which occurs from Kansas to New Mexico and south into Mexico, is conspicuous among the semiherbaceous species listed as herbaceous but having thick woody roots and woody stem bases and really being undershrubs. Its slender, trailing, almost vinelike stems and delicate leaves would theoretically appear to be palatable to livestock. It has been reported as but slightly eaten on the Wichita National Forest, Oklahoma, during the spring when abundant, palatable herbaceous forage was available.

Littleleaf ratany (*K. parvifolia*), which ranges in the mesquite-catclaw type and other dry sites, from Lower California to southern California, southern Arizona, and Sonora, is one of the most palatable cattle browses in the lower foothills of southern Arizona. Russell (104) states that the powdered root is medicinal with the Pima Indians, and that they use it to dye leather red.

White ratany (*K. grayi*, syn. *K. canescens* A. Gray (1852), not *K. canescens* Willd. (1825)) is browsed, sometimes almost to the point of extinction, by all classes of livestock in spring and early summer on Arizona foothill ranges, according to Thornber (132).

BEAN FAMILY (FABACEAE, SYNS. LEGUMINOSAE, PAPILIONACEAE), OFTEN CALLED LEGUME OR PEA FAMILY

INDIGOBUSHES (*AMORPHA* SPP.)

About 15 species of this genus, all native to the United States and Mexico, have been described, of which at least half occur in the Western States. The glandular-punctate leaves of indigobushes, often called false-indigos, indicate active chemical properties, and their membership in the tribe Psoraleae, which contains a number of poisonous and suspected plants, makes it desirable to watch livestock very closely when these plants occur in quantity on the range.

A number of the species are now cultivated as ornamentals, the rich blues and violets of the solitary petals, with the golden-yellow anthers, making a vivid combination.

The generic type is the indigobush (*A. fruticosa*), which ranges from Pennsylvania to Florida, Chihuahua, Saskatchewan, and Minnesota, mostly along or near streams or in canyons, mainly in sandy loam soils. When in sterile condition indigobush is often mistaken for a kind of locust (*Robinia*)—whence the local name, river locust, for the species. It is said that the early settlers used this shrub as a substitute for true indigo (*Indigofera tinctoria* of the Old World) and American indigo (*I. suffruticosa*, syn. *I. anil*, of tropical America).

California indigobush (*A. californica*), often locally known as stinking willow, is a shrub 3 to 10 or more feet high, occurring between elevations of 3,500 to 5,500 feet from about the latitude of San Francisco south into Lower California and east to New Mexico. It has an acrid pungent disagreeable odor and does not appear to be touched by livestock. It is said to have been usefully employed in the Southwest as a windbreak.

Leadplant (*A. canescens*), known also as downy amorpha, false greasewood, shoestrings, and wild tea, and widely distributed from Manitoba and Michigan to Louisiana and New Mexico, is a low, mostly spreading bush, 1 to 4 feet high. The species usually occurs locally and scatteringly, mostly on dry plains and hills, and is grazed sparingly by cattle and horses. There is a local superstition in many places that the presence of this plant indicates the existence of lead ore (72), but the common name, leadplant, appears to refer rather to a plumbic hue than habitat (14). It is a handsome plant, especially when in bloom, and is often cultivated as an ornamental.

Dwarf indigobush (*A. nana*, syn. *A. microphylla*), or dwarf-indigo, seldom over 1 foot high, is a smooth and nearly hairless species, with mostly solitary spikes of fragrant flowers, ranging from Manitoba, Minnesota, and Iowa to Colorado and Idaho, usually in the plains but sometimes in the mountains up to about 9,000 feet.

Desert indigobush (*A. occidentalis*, but merged by some botanists with *A. fruticosa* and by others with *A. fragrans*), locally known as Arizona spicebush (fig. 21), is a fragrant-flowered shrub 4 to 10 feet high, occurring from southern California to Arizona and probably south into Mexico. While it is probably of low value, it should be closely watched as possibly a poisonous plant.

PEABUSHES (PAROSELA SPP., SYNS. DALEA (L.) JUSS., NOT P. BROWN NOR GAERTN., PSORODENDRON, PSOROTHAMNUS)

This is a genus, largely herbaceous and mostly Mexican, of about 150 species confined to the Western Hemisphere, especially in the warmer, drier regions. About 50 species are found in the West, whereof approximately 22 are shrubs and one is usually a small tree. The glandular foliage of the peabushes betokens active chemical properties but their economic significance is almost unknown. The Latin name, *Parosela*, obviously an anagram of *Psoralea*, suggests the very close relationship of the two genera (which were, in fact, united by the early botanists) and indicates the desirability of watching peabushes closely on the range if they occur there in quantity,



FIGURE 21.—A, Desert indigobush, locally called Arizona spicebush (*Amorpha occidentalis*), a fragrant shrub that should be carefully watched if cropped by livestock; B, ventral surface of leaflet (enlarged) showing dotlike glands

in as much as several species of *Psoralea* are reported to be poisonous (95; 118; 81, 1924 ed.). In general, livestock seem seldom to exhibit any fondness for the herbage of the shrubby peabushes of the Western States unless other palatable vegetation is absent or scarce.

Silver peabush (*P. argyraea*) is supposed by stockmen on the Alamo division of the Lincoln National Forest, southern New Mexico, to be poisonous. The species is a low shrub, ranging from western Texas to New Mexico and south into Mexico.

Feather peabush (*P. formosa*), known by a variety of local names, including bastard mesquite, little featherbush, and shrubby pea, grows commonly but usually scatteringly on dry plains and hills of the mesquite-covillea and woodland types, between about 3,500 and 7,000 feet, from western Texas to southern Utah, Sonora, and Chihuahua, and is never over about 2 or 3 feet high. It often has two flowering periods, in spring and late summer. It is sometimes grazed by goats and sheep but perhaps is never important; it has been considered good cattle feed in the Santa Rita region of southeastern Arizona. In full bloom it is a remarkably handsome bush, as its specific name indicates.

Black peabush (*P. frutescens*) is a somewhat smaller species, found in western Texas and New Mexico thence south into northern Mexico, and often common in open rocky slopes of the yellow pine and upper woodland belts, largely between 6,000 and 7,000 feet. Local stockmen hold it to be good goat feed and it is occasionally nibbled by cattle and horses. It occurs on an area of the Lincoln National Forest, N. Mex., where cattle losses have taken place, but a poisonous-plant expert of the United States Department of Agriculture who visited the place deemed that the losses were due to another species.

James peabush (*P. jamesii*), of western Texas, southern Colorado, and New Mexico, with cloverlike leaves, has been noted to be grazed slightly by cattle; it is, however, hardly shrubby.

Bearded peabush (*P. pogonantha*), another semiherbaceous species of the Southwest, has been reported as consumed with apparent readiness by cattle in the Santa Rita region of southern Arizona.

Desertbeauty (*P. johnsoni* and *P. amoena*, perhaps only a variety or form of *P. johnsoni*) is the common name of two very handsome, closely related bushes of the southern Great Basin region and Southwest. They are sometimes locally cultivated or encouraged as ornamentals. There is no direct evidence as yet that these two species have forage significance, although *P. amoena* is thought to furnish some spring browse in the Dixie region of southwestern Utah.

Parry peabush (*P. parryi*), a hairy-leaved undershrub of southern and Lower California, southern Arizona, and Sonora, is cropped more or less by cattle in Arizona after the leaves first appear and while they are fresh and tender.

Tree-pea (*P. spinosa*), the familiar, spiny-twiggged plant of the Colorado Desert region and Sonora, frequently becomes a small tree and is very attractive when (usually in June) the profuse, highly fragrant, violet-blue flowers appear. The herbage is not known to be eaten by livestock but it furnishes scanty but welcome shade to domestic animals in the desert regions and fuel of fair quality for the traveler. Other names for this species include indigobush, mangle, smoke-tree, spiny parosela, and tree parosela.

OTHER IMPORTANT GENERA

Scotch broom (*Cytisus scoparius*), known also as green (or Irish) broom, bannal, besom, and hagweed, is a shrub, about 3 to 5 feet

high, with numerous green, angled, straight, erect, elongated, broom-like stems. The species is a native of Europe now adventive or naturalized in eastern North America from Nova Scotia southward in the coastal plains region, at least as far as Delaware and Virginia and on the Pacific slope as well, ranging from Vancouver Island and western Washington south to California, chiefly along or near the ocean. Its American range is undoubtedly spreading, and in many places it is now abundant, growing on barren and other waste places, sandy plains and dunes, at low elevations.

Although somewhat valued abroad for fodder, Scotch broom is seldom touched by grazing animals on western ranges. It is undoubtedly somewhat poisonous to livestock when in the growing state, the symptoms being slavering, vomiting, staggering, and general paralysis (11, 95). A volatile alkaloid spartein ($C_{15}H_{26}N_2$) and the toxic alkaloid cytisin ($C_{11}H_{14}N_2O$) produce a narcotic effect in the poisoned animal, with paralysis of the central nervous system. Scotch broom has been freely recommended as a soil renovator for barren lands because of the large amount of potash contained in the ash.

Western coralbean (*Erythrina flabelliformis*), often called chilicote by Mexicans and ranchers, is the only species of the large tropical-subtropical coraltree genus (*Erythrina*) occurring in the West. This showy-flowered shrub grows on dry foothills and plains of southern Arizona and New Mexico and south into Mexico. In some places it is abundant and its large, thickish, beanlike leaves furnish cattle browse of low palatability, at least in winter and early spring. The handsome, dark-red seed, the bark, and prickly stems are more or less poisonous (126), but it is very doubtful that the species would cause livestock losses except on grossly overgrazed range.

Kidneywood (*Eysenhardtia polystachya*),²⁰ famous because of the fluorescent properties of its wood (108), is a bush or small tree, 4 to 25 feet high, and is found in southern and western Texas, southern Arizona, and south into Mexico. It occurs on dry plains and foothills, commonly in gravelly rocky sites, and is especially characteristic of barrancas and canyons.

Kidneywood is a species that deserves careful study on ranges where it occurs. Its glandular-punctate character (as well as its close relationship to *Amorpha* and *Parosela*) suggests active chemical properties. However, it is considered good or very good goat browse, and in southeastern Arizona is reported abundant though local, and as constituting one of the best summer and fall browses of the region, eaten by horses and relished by cattle from May to November.

Tesota (*Olneya tesota*) is variously known as arbol (or palo) de hierro, and desert (Mexican, or Sonora) ironwood. Ironwood, and

²⁰ The species has no well-established English name, "kidneywood," a translation of the sixteenth century Latin name for the plant (lignum nephriticum), being here suggested as apropos. The Aztecs knew the plant as coat(i) and tlapalepatli. It is frequently called mountain locust in Arizona, evidently being mistaken for a Robinia. The synonymy is involved, and the plant appears in our manuals and literature under at least 11 different names, the commonest including *Viborquia orthocarpa*, *V. polystachya*, *Eysenhardtia amorphoides*, and *E. orthocarpa*. The whole group of forms seems to intergrade to such an extent that the tendency among more conservative botanists is to regard them as comprising one variable polymorphic species.

its Spanish-Mexican equivalents, are, of course, very indefinite names, being applied indiscriminately to a host of hardwood species. It is a small, spiny-branched tree or large shrub ranging in desert valleys, arroyos, and the like from Arizona to southern California, Lower California, and Sonora. The fragrant lavender or purplish flowers usually appear in May, but sometimes are found as late as July, and are much sought after by bees. The pods usually ripen in August and contain from one to eight seeds. These seeds, when roasted, are edible, having a very agreeable, peanutlike flavor, and are prized by Indians for pinole. Cook (21) has suggested the domestication of the species as a food plant in warm arid regions, and quotes Lumholtz to the effect that cattle may be responsible for the extreme scarcity of *Olneya* reproduction in Mexico, both the young plants and the seeds being eaten by them.

Some difference of opinion exists as to the palatability of the mesquitelike leaves of *tesota* to livestock, but there is no doubt that cattle will eat them readily at certain times of the year, as, for example, when the leaves first unfold after the early spring rains. The tree has been introduced into Hawaii, where Judd (71) reports that animals feed on the nutritious foliage and flowers and grow fat on them. In the dry regions which the species occupies, it is prized by travelers for its shade, its edible seeds, and for the fuel which its remarkably heavy wood affords.

New Mexican locust (*Robinia neomexicana*) varies in size from a thorny bush 3½ or 4 feet high to a small tree 20 to 25 feet tall and ranges from western Texas to southern Colorado, southern Nevada, and south into the mountains of northern Sonora. It occurs sparsely on dry hills but is essentially a species of cool mountain canyons or along streams, often in yellow pine timber and on north slopes, its altitudinal distribution varying from about 4,000 to 9,000 feet. The large, showy flowers appear from April to August and the thin flat pods are usually fully formed by the middle of September.

Save only for the little known, recently described *R. rusbyi*, a species confined to southern New Mexico, *R. neomexicana* is the only species of the genus occurring naturally in the Western States. Chapline (15) lists it as an important browse species of very high palatability for goats in the Southwest. Cattle seem to relish the flowers and, apparently, without harmful effect. It is often observed to be cropped by horses and cattle and is considered fairly good for those classes of livestock. Mule deer graze it closely on the overgrazed Kaibab range. Since the eastern black locust (*R. pseudoacacia*), often called common locust, is known to be poisonous, it would perhaps be safer to regard the western species with suspicion except on goat range.

Mescalbean (*Sophora secundiflora*, syn. *Broussonetia secundiflora*) (fig. 22) is a handsome evergreen shrub or small tree, 8 to 35 feet high and with a maximum diameter of 6 to 8 inches; it has thick and leathery, dark glossy green leaves. A very common name for the species is coralbean, but this is considered more appropriate for the related genus *Erythrina*. Other common names for this plant include colorin, evergreen coralbean, frijolillo, frijolito (131), and mountain-laurel.



FIGURE 22.—Mescalbean (*Sophora secundiflora*), a southwestern shrub or small tree. The large woody pods, satiny outside, are about 2 to 4 inches long and contain one to four bright, scarlet, marblelike seeds that are virulently poisonous

Mescalbean occurs from Texas to southern New Mexico and south into Mexico, being shrubby in the foothills and mountains. It is especially characteristic of dry limestone hills, particularly in

crevices of cliffs, and in New Mexico is scattered in the lower woodland type between about 4,500 and 6,500 feet. It often occurs in places practically inaccessible to livestock, which seems to be fortunate.

Chesnut (17) and the Bureau of Animal Industry report that mescalbean is generally regarded as poisonous to animals. The attractive-looking seeds, formed in the pods in late summer and fall, are virulently poisonous and contain the bitter alkaloid sophorin, which some chemists regard as identical with cytisin. Children have been known to die as a result of eating the seeds, one of which is said to be sufficient to kill an adult human being (59). Indians occasionally use a small quantity of the triturated beans to produce a form of intoxication and delirium from which a coma of two or three days' duration ensues (95, 126, 116).

Gorse (*Ulex europaeus*) is a multibranched bush (pl. 6), 2 to 6 feet high and spreading out to a diameter sometimes of 10 feet or so, the branches very (mostly prickly) leafy, the twigs green and ending in spiny tips. Gorse, known also as furze, Scotch thistle (misnomer), thorn broom, ulim, and whin, is a native of Europe and is fugitive in the United States from Nantucket and eastern Massachusetts to eastern Virginia, along or near the Atlantic coast, and along the Pacific from Vancouver Island to Oregon. Evidently its North American range is slowly spreading. It occurs in waste places, being especially characteristic of dunes and beaches near the ocean, though it adapts itself to xerophytic conditions inland.

So far gorse seems to have been a negligible factor in the western forage crop; the spiny twigs and leaves are uninviting to range livestock, and on some ranges, pastures, and farms the species has become a pest. In the Old World, however, gorse is sometimes used as a winter fodder plant, the season's growth only being employed. The species may have future possibilities in this country for silage or other economic purposes, or, contrariwise, as a pest. Gorse is a good sand binder and has been limitedly planted for this purpose; the lower branches stool out from the base, it survives burial in the sands, and is a copious seeder.

CALTROP FAMILY (ZYGOPHYLLACEAE)

Creosote bush (*Covillea tridentata*) (fig. 23), an evergreen, heavy-scented, resinous, diffusely branched shrub, 3 to 11 feet high, ranging from western Texas to southern Colorado, Nevada, Lower California, and Chihuahua, deserves notice here primarily because of its great abundance. It is known variously as gobernadora, greasewood, hediondilla, and by numerous local (largely Indian or Mexican) names. The synonymy of this species is involved and hardly any two manuals agree as to the nomenclature. Larrea is an older generic name than Covillea but is a homonym and hence untenable. The proper specific name for creosote bush depends on the concept of the individual author, but *C. glutinosa* and *C. mexicana* appear to be synonyms of *C. tridentata*, while *C. divaricata* (the oldest name of all), typical of Chile, is probably a different species.

Creosote bush is a very interesting plant to the ecologist, being perhaps the chief indicator of the Lower Sonoran Zone in the Southwest, and occupies an enormous acreage of desert lands. It is al-

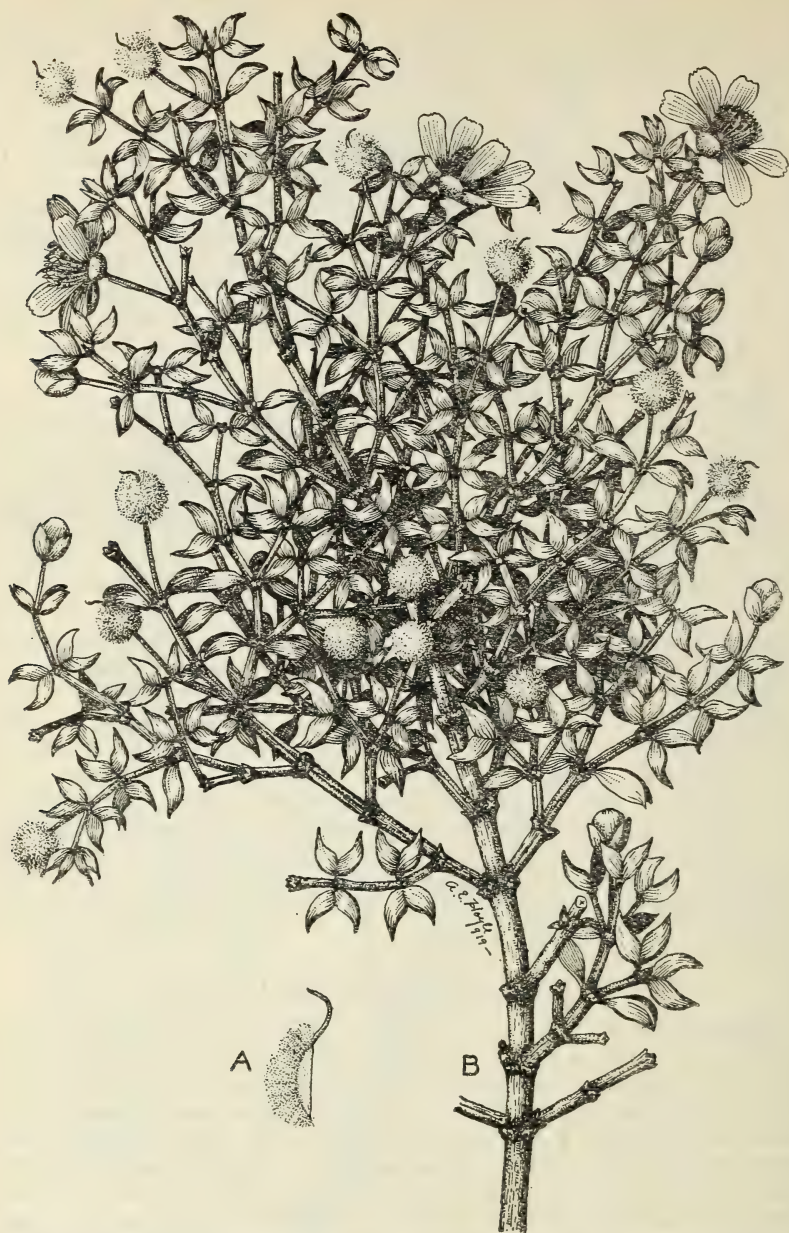


FIGURE 23.—B.—Creosote bush (*Covillea tridentata*). enormously abundant in the Lower Sonoran Zone of the Southwest and perhaps the outstanding indicator of it. It is not palatable to livestock. A, An individual carpel or nutlet

most wholly a minus quantity in the annual range forage crop, as livestock normally will not touch it under any circumstances, but the flower buds are edible when pickled. On the other hand, Griffiths (48, p. 59) reports that sheep are poisoned by it, the greatest

mortality being among pregnant ewes. The species evidently has active chemical properties and would well repay a thorough scientific study. Numerous medicinal uses of the plant are reported (78, 75, 118). It is also locally employed in making an amalgam, glue, or cement (13), as a substitute for shellac and cochineal, and as a hedge plant. The highly inflammable nature of the bush (which burns with a bright blaze, heavy smoke, and penetrating, creosotelike odor) makes it something of a fire hazard.

RUE FAMILY (RUTACEAE)

This is the family to which the various oranges (*Citrus aurantium*, *nobilis*, *sinensis*, etc.), citron (*C. medica*), grapefruit (*C. grandis*, syn. *C. maxima* *var. carpa*), lemon (*C. limonia*), and lime (*C. aurantifolia*) belong.

Starleaf (*Choisya dumosa*, syn. *Astrophyllum dumosum*) (fig. 24), known also as Mexican-orange and, to Mexicans, as sorilla and zorillo, is a low, rather bizarre-looking shrub, with thickish stems and rather slender twigs, warty roughened with glands. It is found from western Texas to southern Arizona, Chihuahua, and Coahuila, growing in dry, sandy, gravelly, or rocky situations, on hillsides, in (often very rough) canyons and arroyos, between about 4,000 and 6,500 or 7,000 feet, i. e., chiefly in the piñon-juniper belt, or Upper Sonoran zone, usually occurring as scattered individual plants.

The gland-toothed leaflets of this shrub have a peculiar, bitter aromatic taste, somewhat reminiscent perhaps of its relatives the citrus fruits. Ordinarily it does not seem to be touched by livestock, but in southern New Mexico it has been considered poisonous to goats, as possibly causing a kidney disease. There is no direct proof, however, that starleaf is responsible for goat losses.

HOPTREES (PTELEA SPP.)

This genus, known also as shrubby trefoil and wafer ash, is confined to the United States and Mexico; there are perhaps two or three species of it in the Southwest, growing as shrubs or small trees among rocks, in canyons, sandy flats, and the like, mostly below 6,000 feet elevation. Botanists differ widely as to the number of valid species of *Ptelea*. About 70 species have been described and the nomenclature in consequence is much confused. The twigs have a bitter taste and the trifoliolate leaves have in most forms a disagreeable odor; livestock, under normal conditions, leave these plants alone. The bark, leaves, and roots of hoptrees have bitter-tonic properties and are employed in medicine. The vernacular name refers to the use of the winged, waferlike fruits as a substitute for hops in making beer. Common hoptree (*P. trifoliata*) is often cultivated as an ornamental.

DESERT-RUES (THAMNOSMA SPP.)

Desert-rue is represented by two glandular, strong-smelling shrubs or undershrubs of the Southwest, unpalatable to grazing animals.

Mohave desert-rue (*Thamnosma montana*), often called turpentine broom and, by Mexicans, cordoncillo, with smooth, green, almost leafless, broomlike stems, is a familiar desert shrub occurring from



FIGURE 24.—Starleaf (*Choisya dumosa*), an ornamental aromatic southwestern shrub, rather closely related to orange and other citrus fruits, and (though perhaps erroneously) suspected by goatmen of occasionally poisoning their bands: A, Fruiting capsule; B, flowering spray; C, detail of leaflet

New Mexico to southern Utah and southern California and south into Mexico and is reputed to have medicinal properties (127). It is agreeably scented when dry, but when fresh the odor is offensive.

Texas desert-rue (*T. texana*, syn. *Rutosma purpurea*), a smaller half-shrubby plant ranging in lower woodland types from western

Texas to Arizona and southward, has no known economic value but appears to have active chemical properties.

MILKWORT FAMILY (POLYGALACEAE)

This family is represented in the West by about 35 species, of which all but one, the southwestern annual, *Monnina wrightii*, belong to the genus *Polygala*. Of the western species of *Polygala*, about half are annual or perennial herbs, a very few (e. g., thorn polygala, *P. acanthoclada*, an ashen-hued, desert species ranging from western Colorado to southern California and Arizona) are definitely shrubby and about 1 to 4 feet high, while the residue represent varying degrees of undershrubbiness. *Polygalas* are typical of warm regions, the genus being best represented in the Southwest. The herbage of these plants, with their acrid milky juice, has a disagreeable flavor and is distasteful to grazing animals. Most, if not all, polygalas evidently have active chemical properties and at least one species, seneca-snakeroot (*P. senega*) is used in medicine. A number of the species are very showy when in full bloom, e. g., spiny polygala (*P. subspinosa*), a dwarf spiny-tipped bush of the Great Basin and Southwest.

SPURGE FAMILY (EUPHORBIACEAE)

This very large, natural plant family produces the greater part of the rubber of commerce. It is represented in the West by at least 24 genera and 170 species. The spurge family is typical of hot, dry climates and, as would be expected, is best developed in the region from western Texas to southern California, the number both of genera and species increasing rapidly as the Mexican border is approached. Probably the majority of western spurges are herbaceous, but a considerable proportion are shrubs or undershrubs, notably *Bernardia myricaefolia*, which grows from western Texas to southeastern California and south into Mexico mainly in deserts. Others include certain species of the genera *Acalypha*, *Adelia* (= *Ricinella*), *Andrachne*, *Croton*, *Ditaxis*, *Jatropha* (= *Mozzina*), *Manihot*, *Securingea*, *Tetracoccus*, *Tithymalus*, and *Trichosterigma*. Florida has three tree genera of this family, including the notorious "deadly" manchineel (*Hippomane mancinella*), but no western spurges are known to be arborescent.

The acrid, milky, more or less poisonous juices prevalent in this family preclude the possibility of any of the species being eaten by livestock unless severe drought or near-starvation conditions obtain. If the plants are cropped to any material degree (especially if in fruit), symptoms of poisoning may be anticipated. Under western range conditions, however, livestock losses from spurges appear to be very rare indeed, and there is no doubt but that at least goats and cattle often nibble species of *Tithymalus*, and perhaps other spurges as well, without any apparent injury. However, the herbaceous beetle spurge (*Tithymalus crenulatus*, syn. *Euphorbia crenulata*) and Palmer spurge (*T. palmeri*, syn. *E. palmeri*) are suspected by cattlemen on the Stanislaus National Forest, Calif. *T. palmeri* is reported as abundant on an area of that forest where losses took place in 1915. Crotonbush (*Croton fruticosus*), a low

bush occurring in western Texas and southern New Mexico and south into Mexico, is suspected by stockmen on the Alamo division of the Lincoln National Forest as being poisonous.

The seeds of many spurges are poisonous, having a violent purgative action; the seeds of other species (sometimes of the same genus), however, are relished by native birds (such as doves, wild turkeys, etc.) which eat them with apparent impunity.

All in all, knowledge concerning the spurges on the western ranges is all too scanty and additional observation both in the field and in the laboratory appears to be demanded.

BOX FAMILY (BUXACEAE)

Jojoba (*Simmondsia californica*) (fig. 25; pl. 8, A), known by a variety of vernacular names, including bushnut, coffee berry, coffee bush, goat-berry, nutbrush, and pignut, constitutes a monotypic genus related to the well-known common box (*Buxus sempervirens*). It is a bushy-branched and spreading shrub, about 3 to 6 feet high, with leathery thick and persistent rather pale leaves about 1 to 1½ inches long. Jojoba is a species of the dry foothills, occurring in Arizona, southern California, and Lower California at elevations of 2,500 to 4,000 feet, and is frequently associated with creosote bush (*Covillea*) and desertwillow (*Chilopsis*).

Goats, sheep, and cattle appear to relish jojoba leaves and tender twigs. Furthermore, the size, abundance, and evergreen character of the foliage, the frequent abundance of the bush in dry sites where there is a relative dearth of palatable associates, and its rapid recovery, when protected from the effects of close cropping, cause the species to occupy an important position among the indigenous browse species of the Southwest. While the plant is undoubtedly nutritious, it would probably be classed rather as a fattening than a muscle-building feed. An analysis of the leaves of this species collected on the Prescott National Forest, Ariz., made for the Forest Service in 1914 by the then Bureau of Chemistry, gave the following result:

	Per cent
Moisture.....	8.83
Ash.....	5.80
Ether extract.....	3.06
Protein.....	7.38
Crude fiber.....	15.41
Nitrogen-free extract.....	59.52
	<hr/> 100.00

The seeds of jojoba have an agreeable nutty flavor, and are a rather important source of food supply among certain Indians. The oil of the seeds has been used in the manufacture of hair tonic, for which purpose the shrub has sometimes been cultivated in parts of southern California. Thornber (132) indicates that the growth of this bush under cultivation is too slow to justify its use in artificial range revegetation; also that the species is spread largely through the instrumentality of squirrels, which collect and hoard the seeds. Jojoba is said to be the chief source of feed for wild goats and deer on some of the large islands off the California coast.



SIMMONDSIA CALIFORNICA

FIGURE 25.—Jojoba (*Simmondsia californica*), an abundant and highly palatable evergreen browse of the Southwest

CASHEW, OR SUMAC FAMILY (ANACARDIACEAE)

To this family belong the well-known economic trees, cashew (*Anacardium occidentale*), mango (*Mangifera indica*), California peppertree (*Schinus molle*), and pistache (*Pistachia vera*). A mem-

ber of the last-named genus, with edible seeds, *P. mexicana*, syn. *P. texana*, *fide* Standley, is native in western Texas.

SUMACS AND SUMAC ALLIES (RHUS SPP.)

At a conservative estimate there are about 18 species of this genus in the West.²¹ The true western sumacs—i. e., *Rhus* in a restricted sense, with pinnate leaves and dense terminal panicles of scarlet, berrylike fruits, of which Rocky Mountain sumac, *R. cismontana*, ranging from Nebraska to Montana and Arizona, may be regarded as typical—embrace about five species wholly destitute of forage value. Sumacs are not lacking in economic interest. The eastern species are employed to some extent in the tanning industry, but little has been done to render these plants as serviceable as they no doubt might be.

In the Southwest are three species of *Rhus*, having thick simple evergreen leaves, and belonging to the genus *Lobadium* of some authors, which includes *Lithræa* and *Neostyphonia*. All are shrubs or sometimes small trees, and are worthless or poor browse except perhaps occasionally for goats. Very closely related to this group is another, nearly always simple-leaved species, Utah sumac (*R. utahensis*, syn. *Schmaltzia affinis* and *S. simplicifolia*), occurring in sagebrush and juniper-piñon types from southern Utah to Arizona and southeastern California; it is often abundant and furnishes local browse for cattle, goats, and sheep when more palatable species are scarce or wanting.

LEMONADE SUMACS, OR LEMITAS (RHUS SPP., SYN. SCHMALTZIA)

The most valuable of the sumacs from a forage viewpoint are the lemonade sumacs, sweet-sumacs, or lemitas (genus *Schmaltzia* of some authors), also known as lametas and three-lobed sumacs, of which about six or eight valid species occur in the West. The acid berries of these shrubs are eaten by Indians and occasionally by whites, and a rather pleasant beverage can be made from at least some of them. Their slender twigs are very important in basketry work among the Indians, which is probably the reason that many people call them squawbush or squawberry. The Indians also powdered the dry berries as a lotion for smallpox.

Lemonade sumac (*Rhus trilobata*), by far the commonest and most widely distributed species of this group, ranges from Alberta to Missouri, northern Mexico, and southern Oregon, and is often abundant on dry rocky hillsides between about 3,700 and 8,000 feet. The palatability of this species to cattle, goats, and sheep varies from worthless or slight to good; in general it seems to be of most value in southern Arizona and perhaps also in southwestern Colorado, in Utah, as a rule, being largely untouched by livestock.

Emory sumac (*R. emoryi*), or velvet squawbush, with densely yellow velvety herbage, occurs in southern Arizona and New Mexico, in dry valleys and arroyos, on foothills and lower mountain slopes,

²¹ In this discussion the thick and mostly simple-leaved sumacs (genera *Lithræa*, *Lobadium*, and *Neostyphonia* of some authors), *Rhodidium microphyllum*, and the sweet-sumacs or lemitas (*Schmaltzia*) are all merged in the genus *Rhus*, but the poison oak, ivy, sumac aggregation (*Toxicodendron*) is held distinct. Numerous specific segregates of the *Schmaltzia* group have been proposed by some botanists.



F167547 F167496 F167493 F167545

A, Myrtle boxleaf (*Pachistima myrsinites*), a western shrub important because of its wide distribution and abundance; B, California buckeye (*Aesculus californica*), the fresh seeds of which are poisonous; C, western soapberry (*Sapindus drummondi*), a widely distributed tree of warm regions and found in Arizona. Occasionally nibbled by cattle it is, because of its affinities, an object of suspicion. It is famous for its saponaceous berries; D, Mexican-buckeye (*Ungnadia speciosa*), a species whose seeds are poisonous



F162811 F22753 F168256

A, Jojoba (*Simmondsia californica*), in cactus-bowlder type on desert range 15 miles southeast of Roosevelt, Ariz.; B, Ocotillo (*Fouquieria splendens*) and pricklypear (*Opuntia* sp.), Stone's sheep ranch, 3,800 feet, Coronado National Forest, Pima County, Ariz.; C, Bluebrush (*Ceanothus integriramus*), in full bloom, Crater National Forest, Oreg.

mainly in the piñon, oak-brush, and covillea belts; it is grazed—sometimes extensively so—by cattle and other livestock, though its average palatability is probably not over fair.

Littleleaf sumac (*R. microphylla*, syn. *Rhoeidium microphyllum*), occurring on dry, "desert" foothills from western Texas to southern Arizona and south into Mexico, is a common, spreading edible-fruited bush of characteristic aspect; it occurs usually in scattered stand and its palatability appears to be very low.

Evergreen sumac (*R. virens*, syn. ? *R. choriophylla*), which ranges from western Texas to southern Arizona and south into Mexico, is reported by Bray (12) to be a pioneer in the vegetation of limestone ledges in west Texas, forming a protection for other species which occupy more slowly the difficult situations. It thus has a local, conservative influence with regard to water supply and erosion.

POISON IVIES AND POISON OAKS (TOXICODENDRON SPP.)

Closely related to the sumacs and sweet-sumacs (*Rhus* spp.), and united with them by some botanists, are the poison oaks, poison ivies, and poison sumacs (*Toxicodendron* spp.), whose juices are very poisonous to the skin of most persons. While more data on this subject are needed, animals as a rule seem not to be affected by this plant, though dogs sometimes have their eyes swollen from nosing around the bushes. There are two western species.

Poison oak (*T. diversilobum*, syn. *R. diversiloba*) ranges from Washington to California and is said to be the most widely distributed shrub in California. It ranks as slight to fair cattle feed.

Western poison ivy (*T. rydbergii*, syn. *R. rydbergii*) occurs from British Columbia to South Dakota, western Oklahoma, Arizona, and Idaho. It is sometimes grazed by livestock but, on the whole, is nearly worthless.

STAFF TREE FAMILY (CELASTRACEAE)

To the staff tree family in the West belong four woody genera, in addition to *Pachistima*, represented by 11 species of shrubs, small trees, or woody vines, all apparently without palatability to livestock.

American bittersweet (*Celastrus scandens*) is an eastern woody climber which gets as far west as Montana and New Mexico and has bitter herbage.

Western wahoo (*Euonymus occidentalis*) and **eastern wahoo** (*E. atropurpureus*), both known as burningbush, are the better known of the three species of *Euonymus* (spelled by some *Evonymus*), ornamental shrubs and small trees occurring natively in the West. The western species ranges from Washington to western Nevada and California, and the eastern reaches Montana.

Greasebush (*Forsellesia spinescens*), known also as greasebrush, is the best known and most widely distributed of the four species of *Forsellesia* (syn. *Glossopetalon*). It occurs from Washington to California, Chihuahua, Oklahoma, and Colorado, mainly in dry, rocky sites at low elevations. Greasebush is of interest to the ecologist as a pioneer species, able to establish itself in solid granite rock.

Mortonia, a genus of three species, all low bushes with small remarkably thick leaves, is found at low elevations, often in limestone sites.

Myrtle boxleaf (*Pachistima*²² *myrsinites*), known also as boxwood, false box, goatbrush, mountain lover, and myrtlebush, is a low, prostrate shrub, with thick evergreen leaves (pl. 7, A), ranging from British Columbia to California, New Mexico, and Alberta, and occurring in mountain woods mainly in the yellow pine-Douglas fir and Engelmann spruce zones. In the Northwest it grows mainly at altitudes between 2,000 and 4,500 feet and in the Great Basin, Colorado, and northern Arizona and New Mexico between 6,000 and 9,000 feet. It is characteristic mainly of moist or fairly moist sandy or gravelly loams in cool open conifer woods, but is not infrequently encountered in drier sites and grows on all slopes.

Myrtle boxleaf is important chiefly because of its abundance and wide distribution; it is usually unpalatable to livestock. Occasionally it is observed to be materially browsed by sheep or cattle, ordinarily, however, where palatable feed is scarce. Lenzie reports that myrtle boxleaf is not eaten in west-central Washington unless desirable forage is absent (as along driveways), but that sickness ensues when it is browsed to a considerable degree. Ingram reports the local repute of myrtle boxleaf in southwestern Oregon as a remedy for kidney and rheumatic disorders. The chemical properties of this species would probably repay study.

MAPLE FAMILY (ACERACEAE)

MAPLES (ACER SPP.)

The genus *Acer* is a large one, the United States ordinarily being credited with about 26 species, including the boxelders, often called ashleaf maples (*Negundo* spp.). Of these about 10 or 11 species are western. In the East, maples are of great importance in the lumber trade, but most of the western species are smaller and outside of bigleaf maple (*A. macrophyllum*) have little, if any, significance in the lumber trade nor in any industry comparable to the maple-sugar industry associated with sugar maple (*A. saccharum*). A number of the western maples furnish at least fairly palatable browse in good quantity and shade for livestock and game animals during the heat of the day.

Rocky Mountain maple (*Acer glabrum*, syn. *A. neomexicanum*) (fig. 26), also called dwarf maple (131) and sometimes known as mountain maple and rock maple, varies in size from a bush about 7 feet high to a small tree. It ranges from South Dakota to Idaho, Oregon, California, and New Mexico, but is probably rare in Oregon and California. Essentially a Rocky Mountain rather than Pacific species, it is replaced westward by *A. douglasii*, syn. *A. glabrum douglasii*, with which it is often confused in the floras. Rocky Mountain maple often occurs in limestone areas and grows on slopes, in canyons, along streams, and in moist flats among timber, such as

²² The spelling is the original one and is the form approved by the American Joint Committee on Horticultural Nomenclature (3) for both the Latin and vernacular name. However, the spelling *Pachistima* adopted by some authors is more in accord with the etymology.

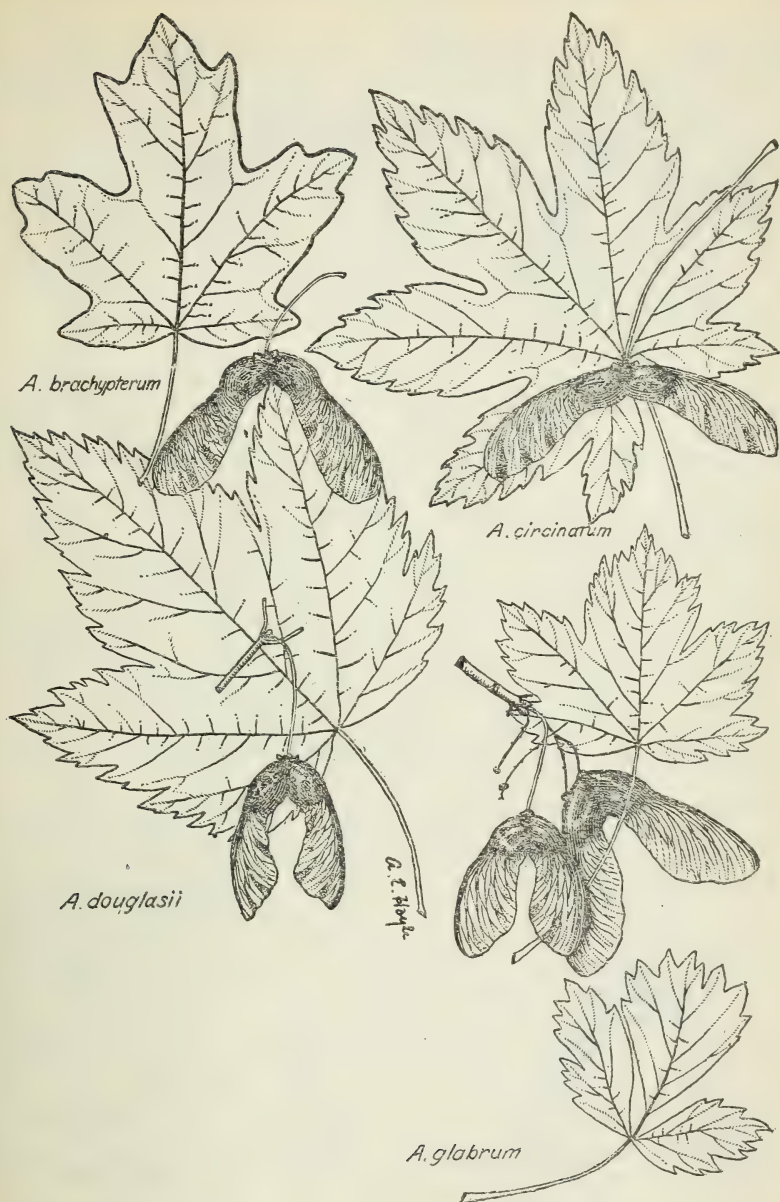


FIGURE 26.—Four common western maples which furnish browse of poor to fair or sometimes good palatability: Southwestern maple (*Acer brachypterum*), vine maple (*A. circinatum*), Douglas maple (*A. douglasii*), and Rocky Mountain maple (*A. glabrum*)

Douglas fir, larch, and aspen. It is most characteristic of porous, sandy, gravelly, rocky loams, but is also met with in rather dry brush sites, frequently associated with serviceberry, spirea, birch, and snowberry. Its forage value varies from poor to good. In west-

ern Montana it seems to be of little importance, but the early sprout growth is browsed freely by deer and elk, and hence it is of value on range reserved for game; in the Rocky Mountain region generally it is of fair value or perhaps only poor in Utah; in southern Idaho it is considered good for both cattle and sheep.

Douglas maple (*A. douglasii*, syn. *A. glabrum douglasii*) (fig. 26), known also as mountain maple and in shrubby forms as dwarf maple, is a shrub or small tree and occurs from Alaska to Alberta, northwestern Wyoming, and northeastern Oregon. It is often common on brush or timber covered slopes, in fairly heavy shade, about seeps and springs, and along streams, at elevations of about 1,500 to 5,000 feet. It attains its best development in rich moist loams and is frequently a companion of willows, alders, serviceberry, oceanspray and mockorange (*syringa*). In Washington and Oregon it is as a rule readily browsed where accessible by both sheep and cattle and in northern Idaho is considered good on sheep range.

Bigtooth maple (*A. grandidentatum*) (fig. 27) ranges from northern Montana to western Texas and high-montane Arizona. It is ordinarily a shrub with firm, rather small leaves, and grows in willowlike clumps about 9 feet high; not infrequently, however, it becomes a small tree 12 to 18 feet high, and farther south it occasionally reaches a height of 30 or 40 feet. The species occurs in canyons, wooded valleys, and western yellow pine woods, usually along or near streams, between 5,000 and 8,000 feet in altitude, and often in limestone formations. It is mostly too rare to have any forage significance but is palatable to livestock when within their reach. In a few places, however, it attains some importance, being a good all-season cattle browse in the Dixie region of southern Utah.

Southwestern maple (*A. brachypterum*), sometimes called short-wing maple (fig. 26), of Arizona and southern New Mexico is of fairly similar browse status and habitats.

Vine maple (*A. circinatum*) (fig. 26) is probably the most valuable browse among the Pacific maples. The common name refers to the straggling, vinelike habit frequently assumed by the species, which is a slender-stemmed shrub or tree, occasionally as much as 30 or 40 feet high but mostly much lower. It is a very tolerant species, forming an understory in Douglas fir and pine woods, associated with dogwood, serviceberry, Douglas maple, etc., and is characteristic between elevations of 1,500 and 5,000 feet, along streams, in rich woods, and on moist sandy loams in bottom lands. The species sometimes grows so thickly in a tangled undergrowth, especially in its optimum range in coastal Washington and Oregon, as to preclude its having any considerable browse utility; but ordinarily in open stand and of relatively low stature, it is a rather important cattle and sheep browse, uniting abundant size and quantity of leafage with fair to good palatability. Because of its handsome foliage, scarlet when it unfolds and in the fall, its slender purple twigs, and scarlet flowers with protruded golden stamens, vine maple is highly ornamental and is cultivated in Europe and the Eastern States.

Bigleaf maple (*A. macrophyllum*), often called Oregon maple, occurs from extreme southeastern Alaska along or near the Pacific



FIGURE 27.—Three other common western maples: Bigtooth maple (*Acer grandidentatum*), inland boxelder (*A. interius*), and bigleaf maple (*A. macrophyllum*)

coast to California. This most valuable Pacific coast hardwood is the largest of the Pacific maples and one of the largest maples in the world, and reaches its maximum size in the rich bottom lands of humid southwestern Oregon. The species occurs along or near streams or about springs in foothills and lower mountain

slopes, sometimes in pure stand in bottom lands, but usually as an understory in conifer forests. In Washington and Oregon it extends to an altitude of 3,500 feet; in the Sierra Nevada it occurs between 2,000 and 5,000 feet.

Although bigleaf maple has the largest leaves among the maples all, or nearly all, the leaves of the maturer trees are usually out of reach of grazing animals. When the foliage is within reach it is cropped with fairly good or good relish by cattle and horses and is of fair to poor palatability for sheep.

Boxelders (section *Negundo*, syn. *Rulac*)

The boxelders, often called ashleaf maples, held by some authors as generically distinct from the true maples, are represented in the West by perhaps six species or varieties, termed by a number of authorities varieties of the eastern *A. negundo*. Probably the most familiar of these are inland boxelder (*A. interius*, syn. *A. negundo interius*) (fig. 27) ranging from Manitoba to Nebraska, and Arizona, and California boxelder (*A. californicum*, syn. *A. negundo californicum*) in California. Boxelders are found in moist places along streams in mountain canyons and the like, but are as a rule too rare and local, and often too large, to figure in the carrying capacity of the ranges, although their palatability is sometimes rated as good.

SOAPBERRY FAMILY (SAPINDACEAE)

The horsechestnut-buckeye group (*Aesculus* and *Ungnadia*) are placed by some botanists in a distinct family, *Aesculaceae*, or *Hippocastanaceae*.

California buckeye (*Aesculus californica*) (pl. 7, B) occurs both as a bushy shrub and as a small tree. It is confined to California and is the only genuinely western representative of its genus. It is essentially a cove species and reaches its largest size in moist mountain valley lands of moderate or low elevation, but is not infrequently met with in drier sites in the foothills, mostly in drainage basins subject to subirrigation.

Both the fruit and leaves of California buckeye are reputed by stockmen to be poisonous, and there seems to be no question but that it should be listed as a poisonous species (17, 66). Chesnut (18) states that the fruit is "a favorite food for squirrels, but hogs will not eat it." Vansell (137) reports losses and disease, sometimes very severe, among California honeybees and their larvae from the effects of the nectar, pollen, and sap of this species.

Hopbush (*Dodonaea viscosa angustifolia*,²³ syns. *D. angustifolia*, *D. schiedeana*) (fig. 28) is a cosmopolitan shrub or small tree found in the warmer parts of both hemispheres, but reported in the United States thus far only from Arizona and peninsular Florida. In Arizona it is mostly a bush 3 to 6 feet high. Wind and birds as agents in seed dissemination presumably account for the remarkably wide distribution of the bush, a distribution which few woody plants can equal. The shrub is fairly common in southern

²³ Some botanists do not recognize the variety *angustifolia*, but merge it wholly into the species *D. viscosa*. Some authors place *Dodonaea* in a family of its own, *Dodonaeaceae*.



FIGURE 28.—Hopbush (*Dodonaea viscosa angustifolia*), a cosmopolitan shrub or tree of warm regions, appearing in the range area perhaps only in Arizona. In times of feed scarcity it should be closely watched; A, Pistillate (female or fertile) spray with samaras or winged fruits; B, staminate (male or sterile) flower; C, seed; D, pistillate flower; E, staminate spray; F, pistillate flowering spray

Arizona, growing scatteringly on hillsides and along dry washes, together with hymenoclea, simmondsia, garrya, and hackberry, at elevations of about 3,000 to 4,500 feet, and often in calcareous soils.

As a rule hopbush is wholly neglected by livestock, but sometimes is nibbled. It should be rather closely watched on the range in times of feed scarcity, as it is known to be used as a fish poison in the West Indies and to contain saponin (95). The leaves are reputed to possess anaesthetic properties; the remarkably hard, attractively colored wood ignites readily and makes a good fuel.

Western soapberry (*Sapindus drummondi*) (pl. 7, C), known also as Drummond soapberry (3), wild china-tree (alluding to its resemblance to the cultivated and related chinaberry (*Melia azedarach*)), Indian soap-plant, and jaboncillo, is a tree, normally 20 to 50 feet high when mature but, when young, spreading and bushlike. Three *Sapindi* are ordinarily accredited to North America: *S. drummondi*, *S. marginatus*, and *S. saponaria*. Rock (103) and a few other botanists prefer to regard this and many or all of the other (approximately nine) species of soapberry natives of the Tropics and Subtropics (and largely African), as variant states or forms of one polymorphic species, *S. saponaria* L. Western soapberry occurs from Missouri and Kansas south and west to Louisiana, Arizona, and Mexico, growing (frequently in limestone soils) along streams and in dry watercourses, on canyon slopes and foothills up to the woodland type, as a rule, however, not being found above about 6,000 feet.

The species is famous for its saponaceous berries, which are used locally for soap and contain 37 per cent of saponin (127). Presumably these berries would prove poisonous if taken internally, although its African congeners are reputed to have edible fruits but poisonous seeds.

The species is occasionally observed to be nibbled by cattle, but it is undoubtedly safest to regard it with some suspicion as browse. Soapberry wood splits easily along the rings and is in local demand for cotton baskets, pack saddles, and fuel.

Mexican-buckeye (*Ungnadia speciosa*) (pl. 7, D), known also as monillo, Spanish buckeye, and New Mexican buckeye, is a monotypic genus. It is usually a bush 4 to 8 feet high, but in favorable situations may become a small tree. It ranges from western Texas, through southern New Mexico, into Mexico, occurring in the foothills and lower mountain slopes, between about 4,500 and 7,000 feet, along streams, in arroyos and canyons, and on rocky declivities, often in calcareous soils.

Livestock are not liable to browse this plant except in times of food scarcity, but it is strongly suspected to have caused occasional losses of cattle and goats in southern New Mexico. Greshoff (95) and Lyons (78) report that it contains the toxic alkaloid saponin, and Havard (59) states that one or two of the seeds may be eaten by an adult without any effect, but that three or four will produce distress in the stomach and dizziness; they are known to have emetic properties. The species is occasionally cultivated as an ornamental shade tree.

BUCKTHORN FAMILY (RHAMNACEAE)

SOAPBLOOMS, BLUEBRUSHES, HORNBRUSHES, ETC. (CEANOTHUS SPP.)

Ceanothus is a large North American genus of about 55 or 60 species, California, with at least 30 species, being the center of dis-

tribution. There are two main sections or groups of *Ceanothi*. The first of these is the section *Euceanothus* which embraces the great bulk of the species, whose alternate, mostly large and thin leaves are, with few exceptions, palatable to livestock. Some of these shrubs are so abundant on the range as to furnish a large percentage of the local forage crop. The other section, *Cerastes*, so named from the horned fruiting capsules which suggest the head of a horned viper, embraces those species with rigid branches, thick, small, leathery, often opposite, sometimes spiny leaves, in general worthless or poor as forage, though the group is often valuable as a nurse crop for conifer reproduction. In general, the *Cerastes* species are characteristic of the drier foothills and low slopes, while most of the *Euceanothi* are more essentially montane and of moister sites.

The seeds of several *Ceanothi* are eaten by Indians as pinole and seem to be nutritious and palatable; the capsules, however, are of varying degrees of bitterness and in many places are wholly rejected by grazing animals. Saponin has been found in certain species of *Ceanothus* (95).

A number of the species of *Ceanothus* have well-established common names. The abbreviated name *ceanoth* has been applied to other members of the genus, but has not been generally adopted. Doctor Coville has suggested use of the name soapbloom (in allusion to the saponaceous properties of the flowers) for those species of the section *Euceanothus* that do not have well-established individual names, and of hornbrush for species of the *Cerastes* section, because of their horned fruits, "horny" foliage, and brushlike growth character. This usage has been adopted in this treatment. Many of the species have showy thyriform, sweet-scented panicles of white or bluish flowers, whence they are often locally known as lilac. The common name, myrtle, is equally untenable for these shrubs.

Section *Euceanothus*

Bluebrush (*Ceanothus integerrimus*, syn. *C. nevadensis*) (fig. 29 and pl. 8, C), is often known locally as sweet birch, the inner bark of the season's twigs having a sweetish sap which possesses a winter-greenlike odor and flavor reminiscent to many persons of oil of sweet birch. White-flowered forms give rise to the name whitebrush. Other local names include blue blossom, blue bush, and deer brush. Bluebrush occurs from Washington to California; also in the mountains of extreme western Nevada and in west-central and southeastern Arizona. It is typically a loose and slender branched shrub 6 to 12 feet high; occasionally, however, it is taller (at least 15 feet) and arborescent, or treelike; on the other hand, it is sometimes as low as 2 feet. In southwestern Oregon occurs a remarkable form with minutely toothed leaves somewhat shiny above and almost as thick as those of *C. velutinus*. This group will require much careful field study before these variations can be satisfactorily catalogued.

The species is one of the most characteristic and abundant shrubs of the yellow pine belt of the Sierra Nevada, though sometimes occurring below the yellow pine belt. It is also common in the higher Coast Range hills and foothills. It is stated to be fairly common along the Verde River in central Arizona, reaching an average height of 4 to 6 feet, between about 5,000 and 6,000 feet elevation.



FIGURE 29.—Bluebrush (*Ceanothus integerrimus*). This is probably the most important single browse species in California: A, Flowering spray; B, fruiting spray; C, individual flower; D, fruiting capsule, with peduncle

While it is found in distinctively dry sites and in a considerable variety of soils, bluebrush is typical of rich moist woods where it attains its best development, a certain amount of shade being conducive to vigorous growth. It is often associated with western thimble-

berry, currants, lupines, bigleaf maple, California hazel, and California black oak.

The large, rather delicate leaves and slender twigs of this bush, with their sweet, birchlike flavor and demulcent juices, are a favorite with livestock, particularly sheep, goats, and cattle. Because of its high palatability, size, abundance, and wide distribution, accessibility, copiousness of the foliage and edible stems, rapidity of growth, ability to stand grazing, and good reproductive powers, bluebrush is among the first west-American browse plants. It is probably the most important single browse species in California—certainly so in northern California and the Sierra Nevada. The species is evidently nutritious since livestock thrive so well on it and the carrying capacity of many California and Oregon ranges is based primarily on bluebrush. It is also a favorite species for deer.

The profuse and handsome panicles of sweet-scented blue (occasionally white) flowers are produced from April to July; and if moisture and temperature conditions permit, there is not infrequently a second blooming season in the fall. These flowers make the species a valuable honey plant and have suggested its use as an ornamental; the flowers are sometimes cropped by livestock, but some stockmen believe they are poisonous. Although saponin has been isolated in bluebrush (95), the percentage, at least in the leaves and twigs, is evidently too low to have physiological significance with livestock on the range. The very bitter, 3-lobed fruiting capsules are sometimes grazed by livestock in winter or when there is a scarcity of feed—apparently on account of the edible seeds they contain; these capsules have active chemical properties.²⁴

Leland S. Smith, a technical grazing man on the Tahoe National Forest, California, who has been making a special study of bluebrush for a number of years in cooperation with Doctors George H. Hart and Arthur W. Sampson of the California Agricultural College, reports that he finds the palatability of this species varies considerably during the grazing season and that this seems to be correlated with differences in the chemical composition of the herbage. Smith finds that if the bush is grazed before the leaves are well formed cattle do not do so well on it. He also regards bluebrush as a fire type and states that it is readily shaded out by pine and fir reproduction.

Trailing bluebrush (*C. diversifolius*), known also as dwarf, or low ceanothus, and squaw-carpet, a trailing or prostrate-spreading, somewhat matlike species occurs between 2,000 and 6,000 feet in conifer woods of northern California and the Sierra Nevada and is fair sheep forage, but is usually local and in scattered patches.

Lemmon bluebrush (*C. lemmonii*), a small California species, with delicate foliage and deep-blue inflorescence, is very palatable to both sheep and cattle, though owing to lack of abundance and wide distribution it can hardly be ranked among the first-class species.

²⁴ At the request of the Forest Service James F. Couch made a study in 1922 of the capsules, seed, and fruiting peduncles of bluebrush. The chemical analyses demonstrated the presence of saponin, but repeated laboratory tests with the material on guinea pigs produced negative results. Doctor Couch expressed the opinion that probably this material would not cause sickness in animals unless there should exist some lesion of the mucous membrane lining the digestive tract to enable ready ingestion of the saponin.



FIGURE 30.—Whitethorn (*Ceanothus cordulatus*), a common thorny-twiggged shrub of the Sierras; its palatability is poor to fair, except perhaps for goats. Even on seriously overgrazed range it is often but little utilized

Whitethorn (*C. cordulatus*) (fig. 30) occurs abundantly in parts of the Sierra Nevada, northern California, and southwestern Oregon. Its thorny twigs, small thickish leaves of obviously inferior palatability, slow growth, and stout short stems make it distinctly inferior

as a browse. Except on overgrazed range it is seldom eaten by cattle or sheep, although more by goats.

Inland Jersey-tea (*C. ovatus*), also called narrowleaf redroot, is primarily an eastern species but ranges as far westward as the north-eastern bases of the Rockies. It is one of the best browse species in the Black Hills region.

Snowbrush (*C. velutinus*) (fig. 31), for which mountain balm, sticky laurel, and tobacco-brush are variant vernacular names, is one of the most widely distributed and abundant of all *Ceanoth*i; its range extends from British Columbia to California, Colorado, South Dakota, and Saskatchewan. It is one of the common chaparral species of California and elsewhere, often forming impenetrable thickets. Its characteristic leaves, whitish beneath, average the largest in the genus, but are thick, sticky, and under normal conditions unpalatable to domestic animals except goats, which will graze it slightly. In certain parts of Idaho the species is sometimes claimed to be fairly good to good sheep feed; material grazing of this shrub by sheep, however, is a sure sign of overgrazing or other starvation conditions. The tough twigs and intricate dense growth further militate against its browse utility. Snowbrush is often a pioneer species in burns.

An attempt (58) to eradicate this shrub and manzanita was made on the Lassen Forest in northeastern California by subjecting the areas to excessive goat grazing. The goats, however, scarcely touched the snowbrush, despite their rather unsatisfactory condition when they came off the range.

Whitebark soapbloom (*C. divaricatus*), sometimes called tall mountain-lilac, a large California and Lower California shrub, frequently occurs as a dense chaparral species in the foothills and lower slopes up to about 5,000 feet. It is of rather limited value as livestock forage but is important as a covert and browse for deer, and the blossoms are locally used as a substitute for soap (118).

Fendler soapbloom (*C. fendleri*) (fig. 32, A, B), known also as buckbrush and deer brush, occurs from South Dakota to western Texas and Arizona; it has been collected at elevations ranging from 4,500 to 11,000 feet, but probably is commonest in brush types of the yellow pine belt. The flowering period extends from late May or early June to late July, the fruit ripening in August and September. Although spiny-twigged, the spray of this species is delicate; and since the leaves are palatable and the species common, widely distributed, and usually abundant, this is a very important browse, occupying to a limited degree in the southern Rocky Mountain region, especially in New Mexico, Arizona, southern Utah, and southwestern Colorado, the position held in California by bluebrush. On the whole it is regarded as a good or very good browse for all classes of livestock, including horses, although farther north it is sometimes held to be only fair—at least on cattle range. It is a famous deer browse.

Martin soapbloom (*C. martini*), a large-leaved, white-flowered bush of Utah and Nevada, is an important local species of high palatability for sheep and cattle.



FIGURE 31.—Snowbrush (*Ceanothus velutinus*). One of the commonest and most widely distributed species of the genus and, except for limited use by goats, worthless as browse: A, Flowering spray; B, fruiting spray; C, undersurface of individual leaf

Red soapbloom (*C. sanguineus*), sometimes called Oregon tea-tree, a red-stemmed, white-flowered species of the Northwest, ranging from British Columbia to western Montana, and northern California, is one of the largest-leaved species of the genus and is of fair to fairly good palatability.

Section Cerastes

Wedgeleaf hornbrush (*Ceanothus cuneatus*), known locally as chamise, chaparral, and greasebush, is a balsamic odorous, often sprawling, pale-stemmed shrub of Oregon and California, growing usually on dry gravelly ridges and slopes. As a rule, beyond a very little cropping, it is neglected by livestock, though sometimes browsed rather extensively by deer. Local stockmen in southern Oregon report that this species, if grazed extensively, has a bad effect on the animals' kidneys, especially the male livestock.

Gregg hornbrush (*C. greggii*) (fig. 32, C, D), known also as desert ceanoth(us), is found from western Texas to southern Nevada and south throughout almost the entire length of Mexico. It is a stout, intricately branched shrub and inhabits dry, semidesert areas perhaps mainly in clayey soils, in browse and weed types of the juniper-piñon and covillea belts, at elevations of 3,500 to 7,000 feet, sometimes being so abundant as to lend chief character to the landscape. Relatively inferior in palatability, it is yet important in view of its abundance and evergreen foliage, being usually fair to good winter and early spring browse for all classes of livestock, especially goats. In some places, especially parts of southern Arizona and southern New Mexico, it is grazed yearlong. The species usually flowers from March to July, largely depending on rains; frequently there is another blossoming period from August to October; flowers are likely to be found at almost any time of the growing season.

Squaw-carpet (*Ceanothus prostratus*), or mahala-mats, of Washington to western Idaho and California is perhaps the best known of the Cerastes species. Squaw-carpet is a prostrate, matlike shrub, with small thick evergreen prickly hollylike leaves, and grows in open conifer forests. Its forage value is slight or negligible.

Secondary Genera of Rhamnaceae

Two species of the very spiny, shrubby genus *Adolphia* occur in the West: *Adolphia californica* in California and *A. infesta* in western Texas. Neither is known to have any forage value and they are sometimes local range pests.

The genus *Colubrina*, also represented in the range area by two species of shrubs, requires further study to determine its precise range significance. *Colubrina* is obviously very closely related botanically to *Ceanothus*, and bears a remarkably close superficial resemblance to that genus, but thus far positive evidence of its palatability to livestock is lacking. *Colubrina texensis* is abundant in parts of western Texas. Another species of uncertain identity, but which may be a form of *C. glabra* of Lower California and Sonora, grows with *simmondsia* and scrub oak in the warm dry foothills of central and southern Arizona.

Condalia, a genus of shrubs and small trees, includes three species of the southwestern United States, *Condalia spathulata*, locally known as squawbush; *C. mexicana*, and bluewood (*C. obovata*), unless, following some authors, the American species of *Zizyphus* be merged in *Condalia*. In general the herbage of *condalias* seems to have very low palatability, but their edible, berrylike drupes make



Ceanothus fendleri

Ceanothus greggii.

FIGURE 32.—A, B, Fendler soapbloom (*Ceanothus fendleri*); C, D, Gregg hornbrush (*C. greggii*), two common shrubs. The former, a Rocky Mountain species, is a very important browse plant. The latter is a southwestern species, of inferior palatability.

them useful in wild-life conservation, and they have some erosion-control value. Bluewood, known locally as brasil, capulin, logwood, and purple haw, often a small tree, one of the commonest chaparral

species of western Texas, forming junglelike growths, is limitedly browsed.

In western Texas occurs one, or possibly two, species of coyotillo (Karwinskia). In 1891 Coulter (24) mentioned a report that the brownish-black berries of *K. humboldtiana*, sometimes called cajo-tillo or margareta, are poisonous; Pammel later (95) quotes A. Mitchell of the Third U. S. Cavalry to the effect that this bush is poisonous to goats. Marsh, Clawson, and Roe (85, 81) have recently found that the leaves are only slightly poisonous and the pulp of the fruit not at all, but that the seeds are highly toxic and affect all domestic animals.

BUCKTHORNS (RHAMNUS SPP.)

This genus is represented in the West by about 14 valid species but has little forage significance. Certain species (notably common buckthorn of the Old World, *R. cathartica*, often cultivated in this country and which has escaped and become naturalized in many localities) harbor the aecidia of crown rust (*Puccinia coronata*) and have caused epidemics of that disease in oats (31, 32).

Cascara buckthorn (*R. purshiana*), also called cascara (131), and locally known as cascara sagrada, chittim, coffee berry, mountain cranberry, pigeon berry, and shittimwood, ranges from British Columbia to western Montana and northern California and is by far the most important species economically, being the source of the medicinal cascara sagrada (sacred bark). Cascara buckthorn is cropped a little by sheep, but is almost negligible as a browse and frequently is out of reach of livestock.

Alder buckthorn (*R. alnifolia*) and **California buckthorn** (*R. californica*), of California, often known as pigeon berry, are two very widely distributed shrubs that furnish poor to fair sheep browse but are virtually worthless for cattle; the berries of the latter are edible and are much relished by birds. Some of the thick, ever-green-leaved species have a very limited browse utility on late fall, winter, and early spring range.

Sageretia wrightii is a spiny-twigged Mexican shrub reaching into the Southwestern States from western Texas to southeastern Arizona. The juicy edible berrylike fruits give it some wild-life interest; but though it deserves further study it has, so far as now known, no forage importance.

JUJUBES (ZIZYPHUS SPP.)

This genus is represented in the Southwest by four shrubby native species, as well as the Old World common jujube (*Z. jujuba*, syns. *Z. vulgaris* and *Z. sativa*), cultivated for its edible fruits, which has become naturalized in parts of the southern United States.

Southwestern jujube (*Z. lycioides*, syn. *Condalia lycioides*), known locally as whitethorn and by a variety of Mexican names including barchatas, crucillo, garambullo, and paloblanco, is the most widely distributed and best known of these native species. It occurs from western Texas to southeastern California and south into Mexico, often in the hoary-leaved variety *canescens*. It inhabits both dry and moist sites from the covillea-mesquite belt to

the woodland type, often forming a well-nigh impenetrable chaparral 3 to 8 feet high. Its palatability to livestock is low, and because of its spininess and manner of growth and the fact that the leaves fall off early its browse status is low, and it sometimes assumes the rôle of a range pest. The fruit has a fleshy but thin, sweetish pulp and is accounted edible.

The other three species referred to seem to have no forage significance, but Parry jujube (*Z. parryi*, syn. *C. parryi*), an often large bush of southern and Lower California, has edible fruits, and Texas jujube (*Z. obtusifolia*, syn. *C. obtusifolia*) of western Texas, locally known as abrojo, lote-bush, and Texas buckthorn, often very abundant on dry slopes, is of value in preventing erosion.

GRAPE FAMILY (VITACEAE)

This family is represented in the West by three genera and about eight species of woody vines. These species are all but negligible as forage because of their infrequent abundance and low palatability, although where the plants do occur the leaves are nibbled occasionally by livestock. All have some value in wild-life conservation. Birds are especially fond of the profuse berries of two ornamental climbers of this family, viz: Treebine (*Cissus incisa*), of western Texas and southern New Mexico, locally known as yerba del buey, and thicket creeper (*Parthenocissus vitacea*), ranging from Wyoming and Utah east to Michigan.

MALLOW FAMILY (MALVACEAE)

This large family is represented in the Western States by at least 21 native genera and 136 native species. The great majority of these are perennial herbs and so will be dealt with in another bulletin. The number of both genera and species in this family increases markedly as one goes southward, and further botanical exploration along the United States frontier from western Texas to southern California will undoubtedly add considerably to the list indicated above. Cotton (*Gossypium* spp.) belongs to this family.

Horsfordia newberryi, a densely stellate-woolly shrub of deserts, dry watercourses, and the like, from Lower California to southern California, southern Arizona, and Sonora, seems not to be palatable to livestock. A shrubby species of pavonia (*Malache lasiopetala*, syn. *Pavonia lasiopetala*) occurs in western Texas and south into Mexico; it may possibly have a little browse utility. In the same region occurs Drummond waxmallow (*Malvaviscus drummondii*), sometimes known as achania and manzanilla, a good-sized bush having edible fruits, which is probably browsed to some extent by sheep and goats and perhaps a little by cattle also; it seems to have possibilities as an ornamental and is reputed by Mexicans and Indians to be medicinal. Widely distributed between elevations of about 2,000 and 7,000 feet in southern Arizona (and ranging south to Jalisco) occurs thurberia (*Thurberia triloba*, syns. *Ingenhouzia triloba*, *T. thespesioides*), a shrubby species sometimes called Arizona wild cotton and algodoncilla. It is hardly palatable to cattle and horses but is nibbled by sheep and goats. It is of much economic

interest as the native host plant of the wild cotton boll weevil (*Anthonomus grandis thurberiae*), which also feeds on cultivated cotton (54).

Of the 12 western species of abutilon (*Abutilon* spp.) a few are undershrubby. In western Texas there also occurs one undershrubby species each of the abutilonlike genera *Pseudabutilon* and *Wissadula*. These may have a little local value on sheep or goat range. On the islands off the southern California coast, forming a remarkable botanical relict, occur two species of treemallow (*Lavatera* spp.) which are said to be grazed by the goats there. One of these species, California treemallow (*L. assurgentiflora*), is cultivated as an ornamental. The treemallows are fiber plants.

By far the largest of the western mallow family genera is globe-mallow (*Sphaeralcea* spp., including the genera *Malvastrum* and *Phymosia*, syn. *Iliamna*, of some authors) with about 60 species; perhaps 10 of these might be classed as undershrubs, some of them being fairly good to good sheep and goat feed. The forage status of the genus, however, will be discussed in a forthcoming bulletin on range weeds.

CACAO FAMILY (STERCULIACEAE)

The most familiar western representative of this essentially tropical family is probably flannelbush (*Fremontodendron californicum*, syn. *Fremontia californica*), a shrub or small tree of California, known locally as Frémontia, mountain leatherwood, and slippery elm. Its twigs are browsed by cattle and sheep and its growth affords protective cover to the low, dry rocky slopes and foothills it inhabits. Two shrubby species of *Ayenia* occur in western Texas, but are probably not grazed by livestock. *Melochia pyramidata* and *Waltheria americana*, two shrubs widely distributed in the warmer portions of both hemispheres, occur in the southern United States and are likely to be found in southern Arizona and New Mexico; both are known to be palatable to livestock.

OCOTILLO FAMILY (FOUQUIERIACEAE)

Only one species of this family occurs in the United States, viz, ocotillo (*Fouquieria splendens*), frequently called candlewood and coachwhip (pl. 8, B), a shrub, leafless for most of the year and of no recorded forage value, worthy of mention here because of its abundance in desert regions from western Texas to southeastern California and south into Mexico. Its flowers and fruiting capsules are a source of food supply to the Coahuila Indians. The bark contains resins and waxes.

ALL-THORN FAMILY (KOEBERLINIACEAE)

This anomalous family, merged by most of the older botanists in *Simaroubaceae* or *Rutaceae*, is represented by two practically leafless monotypic southwestern genera, *Canotia* and *Koeberlinia*. The leaves are represented by small, early deciduous scales and are mere rudiments. Photosynthesis takes place through the stomata of the green stems.

Canotia (*Canotia holacantha*), also called crucifixion thorn, Mohave-thorn, paloverde, and tree of Christ, is placed by some botanists in the Celastraceae. It is a shrub or small tree, 5 to 30 feet high, with ephedralike branches, occurring in Arizona and southern California on hot desert lands at 2,000 to 4,000 feet. Although worthless as browse, the wood is hard and makes good fuel. In parts of Arizona it often grows in pure stands each several acres in extent, and assists in erosion control in sandy soils and dry washes.

All-thorn (*Koeberlinia spinosa*), known also as abrojo, corona de Cristo, crown-of-thorns, and junco, occurs from western Texas to southern Arizona and southward into Mexico, growing on dry gravelly mesas and the like. Occasionally it has a trunk and is a small tree, but usually is a low sprawling intricately branched bush, seemingly entirely composed of thorns, and forming a veritable chevaux-de-frise over considerable areas, making it a great pest to the stockman and traveler. The hard, resinous wood makes a hot fire but the odor is unpleasant. Its growth habit is reminiscent of that of *Holacantha emoryi*, a very thorny, practically leafless shrub or small tree of the Simaroubaceae, or Quassia family, found in deserts of southern California, southern Arizona, and northern Sonora, and also locally called crucifixion thorn and corona de Cristo.

CACTUS FAMILY (CACTACEAE)

This huge natural family of North America and South America is of western range forage significance primarily because of the use of certain *Opuntia* species as emergency feed. However, there are in the family numerous representatives of economic and other interest.

PRICKLYPEARS AND CHOLLAS (*OPUNTIA* SPP.)

Opuntia is a very large genus, best represented in the United States in the strip of southern border States from Florida to California, more especially from Texas westward. The cylindrical-stemmed species are known as chollas, cane-cacti, tasajillas, etc. (fig. 33, A, B), while the flat-jointed species are familiarly known as pricklypears. (Fig. 33, C, D, and pl. 8, B.) There is, however, a wealth of Mexican and aboriginal names for various groups and certain individual and well-marked species.

Obviously the so-called "spineless" or smooth varieties of *Opuntia* are superior to the spiny forms as range livestock feed, but no species of the genus is wholly free from either spines or prickles, and the term "spineless" must be interpreted as a relative one. Unfortunately the spineless species (such as, for example, *O. dillei*, *O. sphaerocarpa*, and *O. treleasei*) are apt to be rare and local on the range and not so aggressive under range conditions as are the spiny species. However, spineless varieties, both native and introduced, are cultivated (especially in Texas) as forage plants. In practical range usage, however, there is a more general tendency to utilize the more common, hardy, and available spiny species by first singeing off the spines with a gasoline torch. When the spines are removed there is no question about the palatability of these plants to livestock and they are a valuable source of water in arid regions.

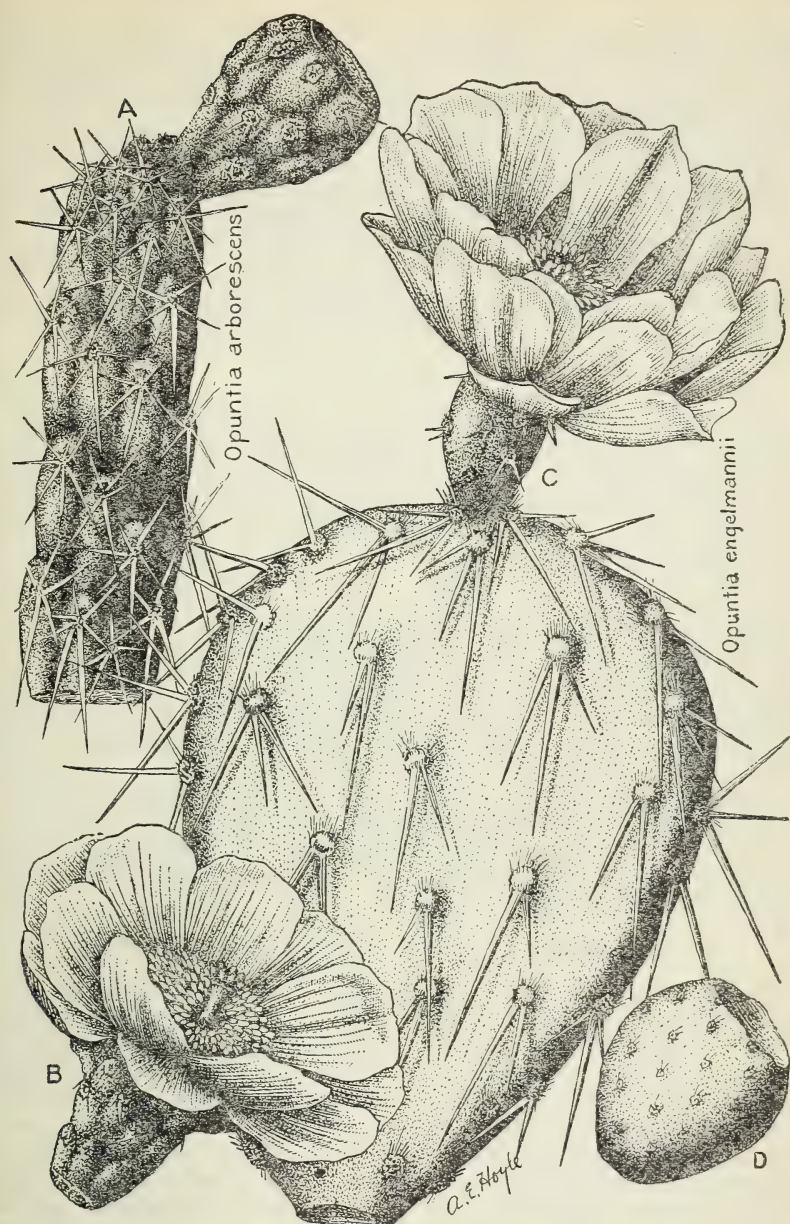


FIGURE 33.—A, Fruiting stem, and B, flower, of a common cholla, or cane-cactus (*Opuntia arborescens*); C, flowering stem, and D, fruit of a common pricklypear (*O. engelmannii*). Species of this genus have forage significance primarily as emergency feed

Numerous chemical analyses have been made and published of pricklypears and excellent results have been obtained in feeding them to livestock as roughage (50, 55, 145, 49), but it is best to give concentrates with them, such as cottonseed cake, grain, or rice bran.

Cactus roughage is extremely succulent and is salty, having a heavy mineral (ash) content; unfortunately it has a tendency to sour unless fed shortly after preparation. If eaten too freely, moreover, it is apt to cause scours. Pricklypears and some other cacti form an important part of the food supply and an indispensable source of water to jack rabbits, kangaroo rats, and other desert animals. Vernon Bailey (5) states that the very abundant Engelmann pricklypear (*O. engelmanni*) (fig. 33, C, D) is the favorite food of jack rabbits in Arizona, and he has ascertained that water makes up 78 per cent of the weight of its pads. The fruit of many of our pricklypears, often known as tunas, is of good quality and valued for human consumption, some of the species being cultivated for their fruits (56).

OTHER GENERA

Ariocarpus (syn. *Anhalonium*) species have both toxic and medicinal properties (95). Mechanical stock poisoning due to hairballs (phyto-bezoars) is not infrequently attributed to cacti, owing to ingestion of large quantities of spines and prickles. Cactus is the State flower of New Mexico. Giant cactus (*Carnegiea gigantea*, syn. *Cereus giganteus*), the State flower of Arizona, also known as saguaro, has good edible fruits. Arizona water cactus (*Echinocactus wislizeni*, syn. *Ferocactus wislizeni*), often called bisnaga or viznaga, is an exceedingly important source of water in the desert and its fleshy pulp is much used locally in making candy. The familiar nightblooming cereus (*Hyllocereus* spp.), commonly cultivated for ornament, is reported by Schneider (118) to be poisonous. The notorious peyote (*Lophophora williamsii*), sometimes called mescal, has dangerous narcotic properties (109). The nopal, (*Nopalea cochenillifera*), often called cochineal cactus, is the host of the economically valuable cochineal scale insect. Several species of cactus, notably queen-of-the-night (*Selenicereus grandiflorus*, syn. *Cereus grandiflorus*), producing a valuable cardiac stimulant, are important medicinal plants.

SILVERBERRY FAMILY (ELAEAGNACEAE)

This is almost universally designated in the manuals as the oleaster family. Oleaster, as now understood, belongs to the olive family (Oleaceae) and is the genuine wild olive of the Old World (*Olea oleaster*), which some say is the original stock of the cultivated common olive (*O. europaea*). Something like 20 species of Elaeagnus are known, most of them being native to Europe, Asia, and Australia. The confusion of this family and the genus Elaeagnus with the true and unrelated olives (*Olea* spp.) seems to go back to the dawn of history. The generic name Elaeagnus signifies "sacred olive." There is some question, however, as to whether or not our genus Elaeagnus—gotten from Tournefort and Linnaeus—is the Elaeagnus of the ancient Greeks.

Silverberry (*Elaeagnus commutata*, syn. *E. argentea* Pursh, not Nutt.), often called silverbush and silver birch, the sole American representative of its genus, inhabits the far North from northern Quebec to Alaska, and south to southeastern British Columbia, northern Utah, South Dakota, and Minnesota. It is usually a

silvery, scaly, bushy, stoloniferous shrub 6 to 12 feet high, rarely becoming a dwarf tree 15 or 16 feet high. The large leaves are densely silvery-scurfy on both faces.

Silverberry is ordinarily met with in sandy soils along streams or else on moist hillsides from approximately sea level in the far North up to subalpine-alpine elevations in the mountains at the southern extremity of its range. It is often common and plentiful, growing in scattered patches, frequently in conjunction with willows. Apparently the foliage of this shrub is not palatable to domestic livestock, though they may sometimes take the fruit.

BUFFALOBERRIES (LEPARGYREA SPP., SYN. SHEPHERDIA SPP.)

Lepargyrea is a wholly north and west American genus of three species.

Russet buffaloberry (*L. canadensis*) (fig. 34, A, B), known locally as Canadian, or thornless buffaloberry, nannyberry, scurfy shrub, soopoo-lalia, or soopolallie (Indians), wild oleaster, and wild olive, ranges from Newfoundland and Labrador to Maine, western New York, the Black Hills, northern New Mexico, eastern Oregon, and Alaska. It is a thornless bush 2 to 10 feet high, with the sexes distinct, bearing russet-brown scurfy shoots, and a prolific crop of rather sour fruits.

L. canadensis is typical of moist, open wooded slopes in the mountains at 3,000 to 11,000 feet—mainly in the lodgepole, aspen, and (upper) yellow pine belts. While usually local it is sometimes very abundant and even a predominating shrub, often becoming heavily established in old burns, especially on north slopes where lodgepole pine is coming in, forming an intermediate succession until the lodgepole becomes too dense for the buffaloberry to survive.

It has little or no browse value for cattle and is usually considered worthless for sheep, but in Idaho and Montana it is often regarded as of limited to fair value for sheep before frost.

Silver buffaloberry (*L. argentea*) (fig. 34, C), locally known as buffaloberry, bullberry, and rabbit berry, has a somewhat similar, though slightly more restricted range than *L. canadensis* and, on the whole, is not quite so abundant or common. It is, however, not infrequently plentiful, growing on moist hillsides, along streams, and in bottom lands, at 3,500 to 7,500 feet. It is a worthless or indifferent browse, inferior to russet buffaloberry because of its thornlike twigs and the rather smaller and more scurfy leaves.

Roundleaf buffaloberry (*L. rotundifolia*) (fig. 34, D-H) inhabits warm, dry, sandy or rocky slopes, and is confined to southern Utah and the Grand Canyon region of Arizona. The species is of low sprawling habit and has thick evergreen leaves densely scurfy beneath. It is reported to be a valuable winter browse in southeastern Utah.

DOGWOOD FAMILY (CORNACEAE)

DOGWOODS, CORNELS, AND BUNCHBERRIES (CORNUS SPP., SYNS. CHAMAEPERICLYMENUM, CORNELLA, CYNOSYLLON, AND VIDUA)

This familiar genus consists of shrubs and small to moderate-sized trees. Cornus species, of which about 16 are found in the West, are typical of moist woodlands, mostly as an understory in the shade of

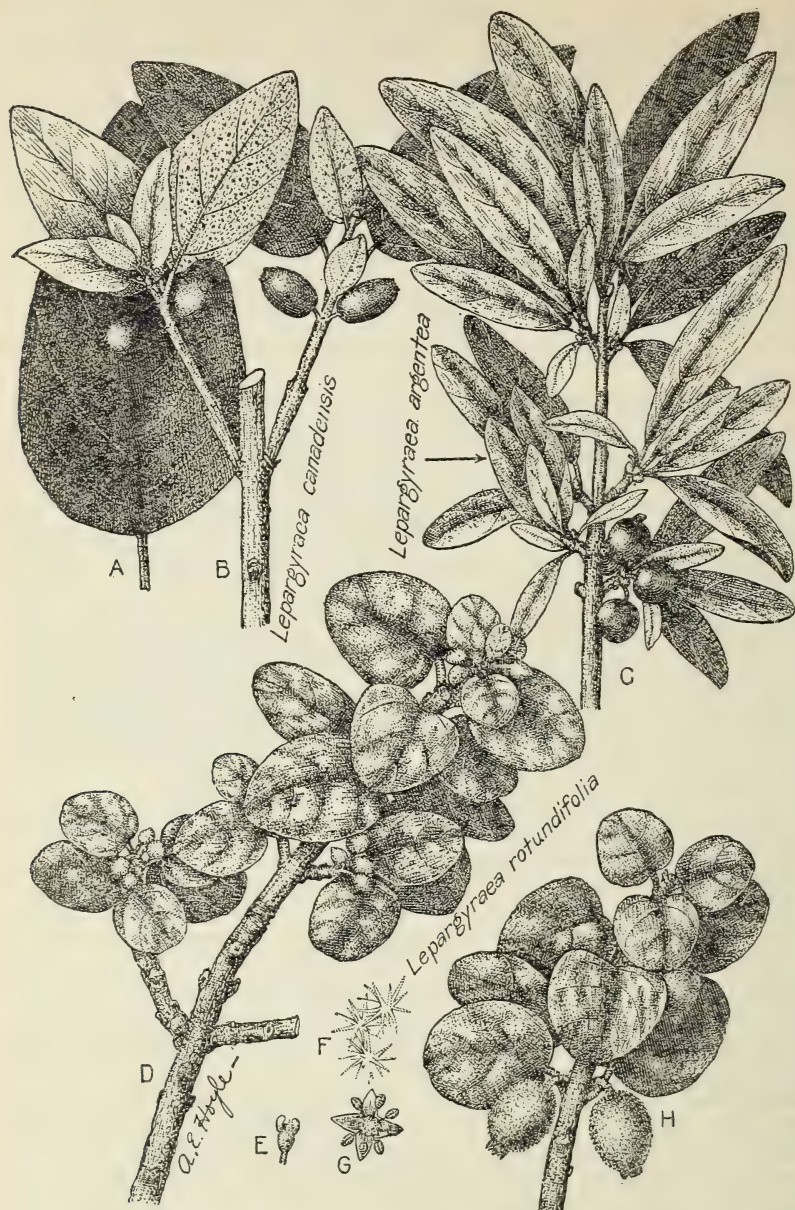


FIGURE 34.—The three species of buffaloberry (*Lepargyrea* spp.) Their berrylike fruits are more or less edible. *L. canadensis* has limited browse utility; *L. argentea* is practically unpalatable; *L. rotundifolia* has a very limited distribution but is valued on winter range. A-C are self-explanatory. D-H, inclusive are of *L. rotundifolia*; D, a budding staminate (male) spray; E, an individual pistillate (female) flower opening; F, stellate (star shaped) hairs found on under-leaf surfaces, calyces, fruits, etc.; G, an individual staminate flower; H, pistillate spray with mature berries

taller growth such as conifers, occurring along streams, in rich bottom lands, about springs, in moist or wet meadows, and the like. In flower they add much to the beauty of the woods, but except for

stream control and the prevention of other erosion and as shade for stock their economic value as a group is somewhat small. Their juices are, as a rule, too bitter to render them palatable to grazing animals except, to a moderate degree, in the late fall. Their bitter bark has resulted in their local employment as a substitute for quinine (*Cinchona*).

Red-osier cornel (*C. stolonifera*),²⁵ or dogwood, known by many local names such as dogberry tree, guttertree, redbrush, shoemack, squawbush, and waxberry cornel, is the commonest of the western cornels. It ranges from Newfoundland and Labrador to Yukon Territory, California, New Mexico, Kansas, and Virginia, and occurs mainly as a riparian shrub, 3 to 10 feet high, from near sea level up to 8,500 feet or even higher in the mountains, often associated with willows, aspen, alders, and birches. The herbage is bitter and under normal conditions is not agreeable to livestock; sometimes, however, it is observed to be cropped slightly by sheep, goats, and cattle, more especially in the fall, when the palatability (at least in Colorado and Wyoming) may range as high as fair.

Western cornel (*C. occidentalis*, syn. *C. pubescens* Nutt. (1849), not *C. pubescens* Willd. (1818)), another dogwood, while usually classed as a shrub is not infrequently a small tree about 20 feet high. It is often common on bottom lands, stream banks, and other alluvial soils, from 2,500 to 6,500 feet in elevation, ranging from British Columbia to California and east to Nevada and Idaho. Ordinarily this species is disregarded by livestock, but in northern California it has been grazed to some extent in the fall by cattle and less by sheep and goats.

The bunchberries, frequently called herb dogwoods and dwarf cornels (*Cornus canadensis* and allies), are segregated by some authors into the genus *Chamaepericlymenum*, syn. *Cornella*. They are almost herbs, being woody at the stem bases only, and are northern, montane or arctic, acid-soil plants, consisting of two or perhaps three species. They are ornamental little plants but have no range value; they may perhaps occasionally act as a nurse crop for valuable conifer or other timber species.

SILKTASSELS (*GARRYA* SPP.)

At least 14 species of *Garrya* are well distinguishable, all of which with the exception of a single species in the West Indies, are confined to the Western States and Mexico. Only one of the species, Frémont silktassel (*G. fremontii*) (pl. 9, A), locally called bear brush and California feverbush, occurs as far north as Washington. Where this shrub has come in on burns in southern Oregon it is reported to have been sometimes 25 per cent grazed, and it is said that some local stockmen regard it as a principal winter browse species. One species only, yellowleaf silktassel (*G. flavescens*), is found in the Rocky Mountains north of the Arizona-New Mexico line, and that extends only into southern Utah and Nevada. The

²⁵ Appears in some of the books under the names *Cornus instolonea*, *C. stolonifera riparia*, and *Svida stolonifera riparia*. *C. stolonifera* is typical of New England and eastern Canada, but there seems to be no constant mark of distinction between the eastern and western forms. Western material perhaps has a more marked tendency to sucker out and form broad clumps.

rest of the continental species are indigenous to the region from west Texas to California and south into Lower California and Mexico. The genus, therefore, may be regarded as typical of warm, dry climates; in general, the herbage is of low value for cattle but moderately palatable to goats.

Wright silktassel (*Garrya wrightii*) is a shrub, known by a variety of local names—bearberry, chaparral, coffee berry, feverbush, gray-leaf dogwood, and quinine-bush, varying from 1½ to 10 feet high, the branches more or less four angled. The leaves are thick, leathery, and evergreen. As is the rule in garryas, practically all parts of the plant are permeated with an intensely bitter, quinine-like principle. It grows from extreme western Texas to central and southern Arizona, being found on dry, rocky hills and canyons, more especially in the woodland (piñon-juniper) type, at 5,000 to 8,000 feet, associated with oak brush, mountain-mahogany, manzanitas, and *Rhus* spp. In many places this evergreen shrub is regarded as worthless or of but slight value for livestock, but in southern Arizona it is sometimes grazed moderately by cattle from December to June. Chapline (15) reports its palatability as moderately high for goats, especially in summer.

Tasseltree (*G. elliptica*), sometimes called tree silktassel, ranges from Oregon to California and is grazed to some extent by goats. It appears to be the only arborescent species of the genus outside of Mexico and the only one in cultivation (3).

Goldman silktassel (*G. goldmanii*) of western Texas and southern New Mexico, an unusually small and hairy species, is generally regarded as good goat feed.

HEATH FAMILY (ERICACEAE)

This family is to a large extent an aggregation of cold northern bog and forest inhabiting species. Except Gaultheria the native northern ericaceous species occurring in moist sites appear to be largely more or less poisonous. In the Southwest the family is represented only by the dryland (xerophytic) hard-leaved genera, *Arbutus* and *Arctostaphylos*, which are both harmless groups. As a family, ericaceous plants are noteworthy for their predilection for acid (sour) soils.

BOG-ROSEMARY (ANDROMEDA)

Bog-rosemary (*Andromeda polifolia*), known also as wild rosemary, marsh holy-rose, and moorwort, laps over from the far North into Washington and Idaho and occurs in cold bogs of both hemispheres. It is a rather small bush, 1 to 3 feet high, with evergreen, narrow, acid-tasting leaves, whitish beneath. Many botanists regard this as the only species of the genus. Like many other species of this family, bog-rosemary contains the virulently poisonous glucoside andromedotoxin²⁶ (95). This species, however, has seldom, if ever, figured in western losses of range livestock, as it is probably

²⁶ Andromedotoxin ($C_{31}H_{51}O_{10}$) is a virulently poisonous bitter-tasting substance found in *Andromeda* and some other ericaceous genera. It occurs as white, needlelike crystals, is "more emetic than emetin," and causes vertigo, arrest of blood circulation, and paralysis of the brain centers.

very local, often occurs in inaccessible places, and is normally rejected by grazing animals. It is known, however, to have killed sheep (17). Its evergreen leaves would doubtless prove a temptation if livestock were admitted to an andromeda area too early in the spring.

MADRONES (ARBUTUS SPP.)

Arbutus is a small genus of both hemispheres, closely allied to the manzanitas (*Arctostaphylos* spp.); the species are mostly small trees. In the United States the genus is confined to the Pacific States and the Southwest, where four species are found.

Pacific madrone (*A. menziesii*), often but incorrectly called California-laurel and more usually known simply as madrone or madroño, is probably the best known species. This highly ornamental species ranges from Vancouver Island and southern British Columbia to California (west of the Cascades and Sierra Nevada) and probably extends into northern Lower California. In its more northern range it is often a large tree. The species is found on a very considerable variety of sites, at low to moderate elevations, reaching its largest size in humid coastal sites, and is usually shrubby in dry, sunny, or sterile sites. It is a frequent component of the understory in redwood, Douglas fir, live oak, and western yellow pine forests. Goats will crop the leaves and sprouts with considerable avidity, and sometimes will peel the bark. Occasionally cattle will graze it lightly, but this is usually due to shortage of more palatable vegetation.

The fruit of madrone is eaten extensively by deer, and Chesnut (18) reports it a favorite food of doves, wild pigeons, turkeys, and poultry. It produces tanbark and is a famous bee plant. The leaves are reported to possess medicinal properties.

Texas madrone (*A. texana*), also called madroño, perhaps only a variety or form of Mexican madrone or madroño (*A. xalapensis*), is a common and somewhat similar species found in foothills of western Texas and southern New Mexico and is occasionally browsed by goats and cattle.

Arizona madrone or madroño (*A. arizonica*) seems not to be grazed, except possibly by goats.

MANZANITAS (ARCTOSTAPHYLOS SPP.)

Manzanitas form an essentially west-American, primarily Californian, group of about 40 species of shrubs and small trees, of which all but bearberry (*Arctostaphylos uva-ursi*) are confined to western and southwestern North America. Mainly their branches are tortuous and the leaves thick and persistent evergreen. Many of the species hold their leaves in a vertical position by a twist of the petiole, or leafstalk—apparently a device to reduce transpiration. Manzanita is one of the most characteristic chaparral genera of California and Oregon, covering millions of acres, mainly slopes and burns, with a more or less impenetrable thicket of intertwined branches. The majority of the species reproduce extensively by root shoots, and so tend to survive fires and to occupy burned-over timberlands. In these two States manzanitas are largely regarded as pests, the problem being how to supplant them with a type of vege-

tation suitable for producing wood, livestock products, or anything economically utilizable. Except in the Southwest, and for goats, which will graze them along with other feed, manzanitas are practically worthless as forage. The two commonest and most widely distributed species of manzanita are undoubtedly greenleaf manzanita (*A. patula*) and bearberry (*A. uva-ursi*). Bears, turkeys, and other wild life are fond of the berries.

Greenleaf manzanita (*A. patula*, syns. *A. platyphylla* and *A. pungens platyphylla*) (fig. 35) ranges from Oregon (through southwestern Idaho) to extreme western Colorado, Utah, and California, between about 5,000 and 7,500 feet in elevation, on dry well-drained sites, brush and woodland or lower yellow pine types, often in admixture with mountain-mahogany, oak, garrya, and *Ceanothus fendleri* and *greggii*. It is found in dense stands on dry slopes and in old burns, in full sunlight, and is easily the commonest manzanita in the Great Basin region and one of the commonest Pacific manzanitas. The ability of greenleaf manzanita to withstand repeated burning and make rapid new growth by root shoots is phenomenal. In Oregon and California it is practically worthless as a range plant. Experiments for its eradication by goats conducted on the Lassen National Forest in California showed about 75 per cent of the aerial growth of the manzanitas girdled and killed during the first season where the goats were concentrated, but the second year's efforts practically failed (58). Goats concentrated on the species quit the range in poor condition. In the Great Basin greenleaf manzanita is held to be poor to fair goat feed and, aside from utility as an emergency feed in winter for sheep and cattle, is worthless for other stock.

Pointleaf manzanita (*A. pungens*) is grazed rather freely by goats (15) in the Southwest, the finer leaves and more tender twigs being eaten. The occurrence, however, of this species is usually rather scattering. In spring goats often peel the bark, presumably for the sap.

Bearberry (*Arctostaphylos uva-ursi*) (fig. 35), or kinnikinnick, as it is often called in the Rocky Mountain region, is much the most widely distributed species of the genus and the only species occurring in the Old World unless one includes in *Arctostaphylos* the deciduous-leaved juicy and dark fruited, arctic-alpine genus *Mairania* (= *Arctoïus*) and which is represented in Alaska, Yukon, British Columbia, and Alberta at least by ptarmiganberry (*M. alpina*). Bearberry ranges from northern and high-montane Asia and Europe to North America, where it is found from Labrador to Alaska and south to about the southern boundary of New Jersey, Illinois, Nebraska, in the Rocky Mountain chain south to Mexico, and in the Pacific cordillera to California. It forms a low ground carpet in the shade of (mostly conifer) timber, in both moist and dry sites, and is often very abundant. Deer will occasionally crop the leaves, but as a rule it is worthless for domestic livestock, though sometimes goats and sheep nibble it. Grouse, turkeys, and bear are all very fond of the berries, so that the species deserves consideration from the standpoint of game conservation. It also tends to favor timber reproduction and is sometimes an important nurse crop.

Pinemat (*A. nevadensis*), sometimes called pinemat manzanita and Sierra bearberry, is closely akin to bearberry. It is a common species

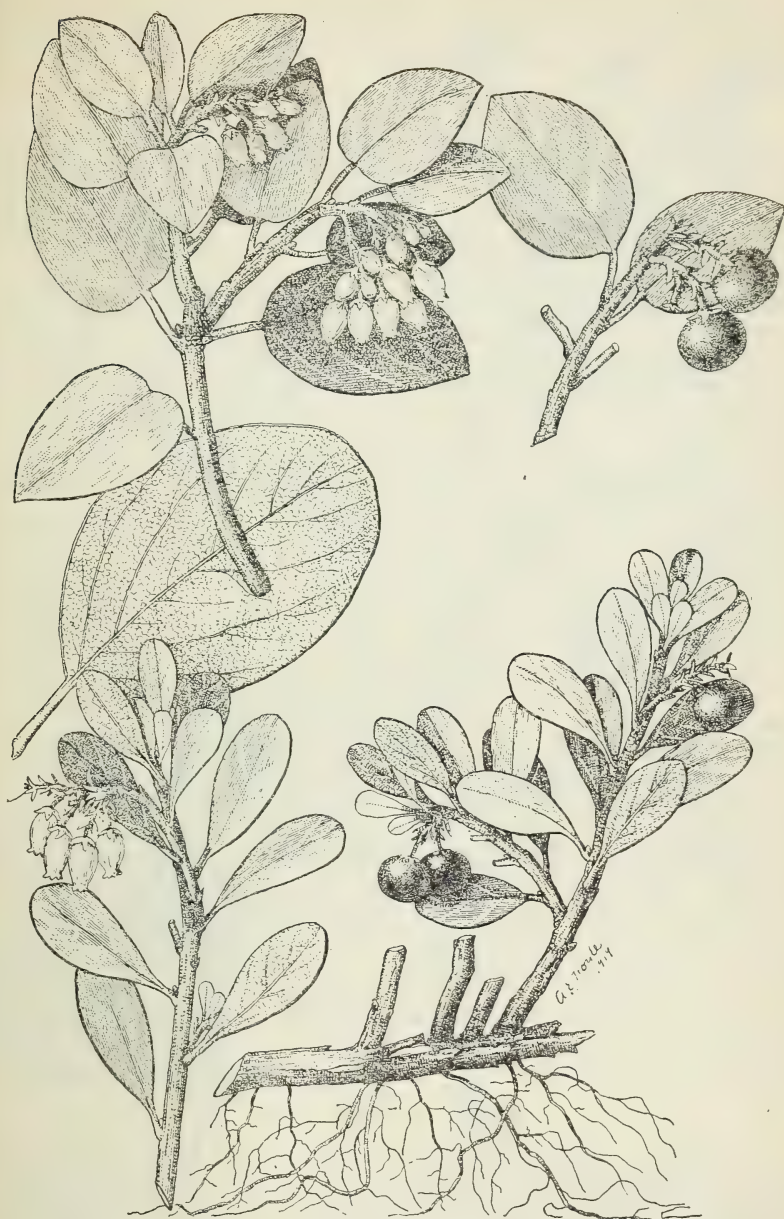


FIGURE 35.—Above: Leaf, flowering spray and fruiting spray of greenleaf manzanita (*Arctostaphylos patula*). Below: Flowering spray and fruiting shoot of bearberry or kinnikinnick (*A. uva-ursi*). These species are important from the standpoints of abundance and wide distribution rather than as forage, for which purpose they are worthless to poor or sometimes fair for goats in the case of *A. patula*. The Greek name *Arctostaphylos*, the Latin word *uva-ursi*, and the English word bearberry all refer to the fondness of bears for the berries of the species

at subalpine elevations in the Coast Range, Cascades, and Sierras, from Washington to California, and often useful in checking erosion on slopes. In parts of the Sierra Nevada it is sparingly browsed by cattle.

AZALEAS (AZALEA SPP.)

Azalea is a genus of about 50 species, mostly Asiatic. Approximately 9 species occur in the Eastern (mainly Southeastern) States and only 1 species in the West. Many of the best authorities merge *Azalea* in *Rhododendron*, but, at least in North America, the two groups are quite distinct, though it is possible they may intergrade in Asia.

Western azalea (*A. occidentalis*) (fig. 36) is a handsome, fragrant-flowered shrub 2 to 10 feet high. It is often called California azalea and is one of the numerous ericaceous shrubs promiscuously called laurel, mountain-laurel, sheep laurel, and by other modifications of the term laurel. *Azalea* is not a member of nor closely related to the laurel genus (*Laurus*) or family (*Lauraceae*), nor does it resemble them. Western azalea is confined to California and southwestern Oregon, occurring on stream banks, about springs, in wooded canyons and the like, on western slopes of the Sierra Nevada and in the Coast Range. It is mostly found in conifer woods, in moist rich loam, at 1,800 to 5,500 feet, associated with such woody plants as alder, willow, cornel, yew, and serviceberry. Contrary to some species of the genus it flowers from May to July, after the leaves appear. In some areas western azalea has a rather bad reputation for poisoning sheep, and occasionally cattle also, especially in spring and in new or unfamiliar places (76). Marsh (81) indicates that the sheep losses from western azalea are "considerable."

False-azalea (*Azaleastrum albiflorum*, syns. *Rhododendron albiflorum* and *Azalea albiflora*), known also as white-flowered rhododendron and Rocky Mountain rhododendron, is a shrub 2 to 6 feet high, which occurs commonly in mountain woods up to alpine elevations from British Columbia to northern Oregon, Idaho, and western Montana. Recently it has been collected in northwestern Colorado, a very considerable extension of range; presumably it occurs also in western Wyoming, but appears never to have been collected there. There is practically no question but that the species is poisonous (81), and it is reliably reported to have caused sheep losses on the Routt National Forest in Colorado, probably as a result of too early admission to the range in spring or perhaps of overstocking. Under normal range conditions the shrub has a palatability percentage close to zero.

CASSIOPE (CASSIOPE SPP.)

Cassiope is a group of about 8 or 10 rather low, tufted, evergreen, boreal or high-montane, heathlike shrubs, with somewhat the habitual aspect of clubmosses. The species are frequently called moss plants, moss-heathers, and white (or pink) heather. Heather, as a generic name, should be confined to the genus *Calluna*, and heath to the genus *Erica*.

Two species occur in the Western States, *Cassiope mertensiana* and *C. tetragona*. These are found only on the summer ranges of the high mountains, at alpine-arctic elevations, and are not infre-



FIGURE 36.—Western azalea (*Azalea occidentalis*), a common species of moist woods in California and southwestern Oregon, with showy, fragrant flowers. It sometimes causes sheep losses: A and C, leaves; B, twig with fruiting capsules; D, flowering spray

quently inaccessible to domestic animals. Their herbage is normally rejected by livestock and such economic value as they possess seems to be confined to their slope-protective, erosion-preventing qualities, their ornamental value, and to the fact that ptarmigan are very fond of the flowers. Mertens cassiope (*C. mertensiana*), much the com-

moner of the two western species, ranges from Alaska to western Montana, Oregon, and northern California. Sheep will not touch this plant unless hungry; Lenzie states if they eat it to any considerable degree from starvation sickness ensues.

WINTERGREENS AND SALAL (*GAULTHERIA* SPP.)

The genus *Gaultheria* is a very large one, of world-wide distribution, but mostly confined to the Andean cordilleras of South America.

Bush wintergreen (*G. ovatifolia*) and **western wintergreen** (*G. humifusa*, syn. *G. myrsinites*) resemble the wintergreen (*G. procumbens*) of northern and eastern North America, from which the commercial oil of wintergreen is distilled; and it is not unlikely that the western species might also yield this valuable oil. The scarlet fruits of these three native wintergreen species are edible, with an agreeable spicy wintergreen flavor, and form a not unimportant part of the diet of birds (such as grouse and quail), deer, and other wild life.

Salal (*G. shallon*) (fig. 37) is a shrub 1 to 6 feet tall, with stout and spreading branches. The thick evergreen leaves are usually glossy on the upper surface. Salal occurs from Alaska to California (west of the Cascades and Sierra Nevada), and is a very common and characteristic forest-floor species, associated with Oregon holly-grape, bracken, "huckleberries," and Scouler willow in dry sterile soils, and found also in the more moist and fertile soils of Douglas fir and Sitka spruce forests. The herbage is not palatable to livestock, but the fruit is edible, with a spicy aromatic flavor, and the species was an important food plant among the aborigines of the Northwest.

KALMIAS (*KALMIA* SPP.)

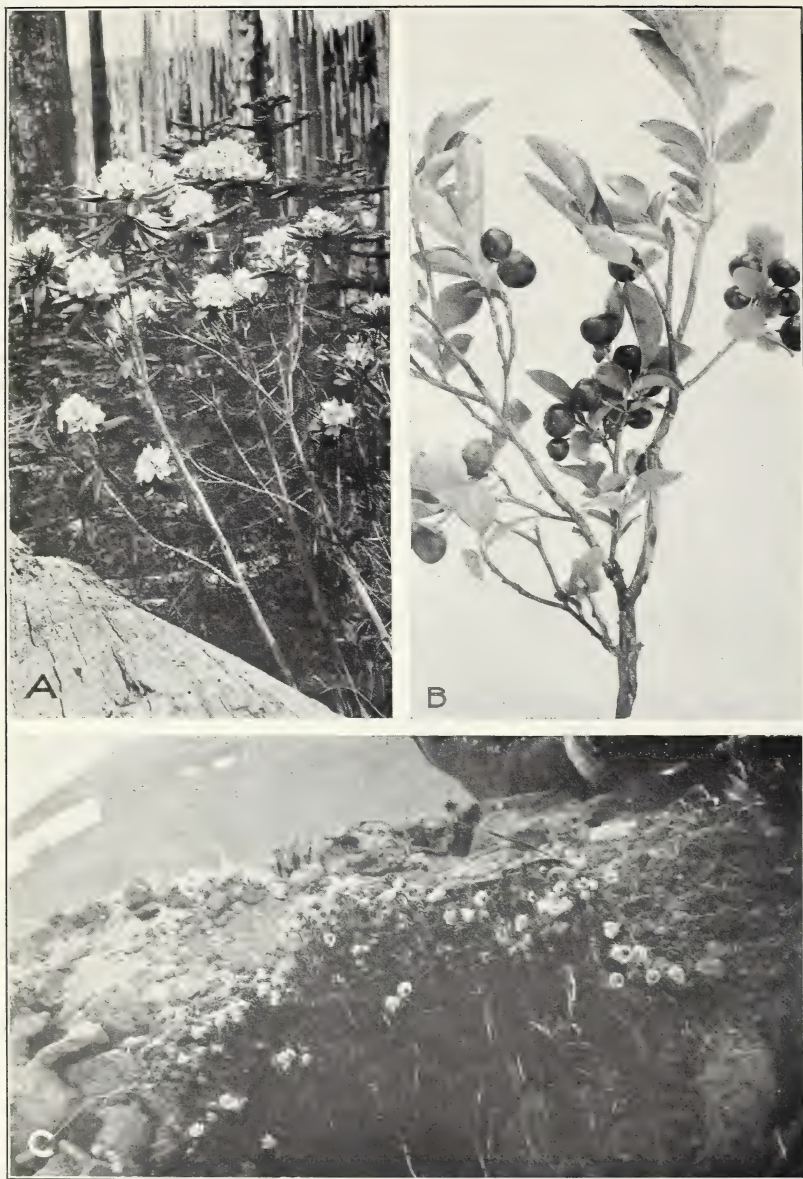
Kalmia is a North American genus of six species, of which two are native to the West. *Kalmias* are frequently called laurels, but belong to a different family than the true laurels (*Laurus* spp.).

Alpine kalmia (*K. microphylla*, syns. *K. polifolia microphylla* and *K. glauca microphylla*), often called dwarf or alpine bog kalmia, is a low bush, usually 4 to 12 inches high, inhabiting cold, subalpine bogs from Alaska to Colorado and California. (Fig. 38.) Normally livestock do not touch this species, but instances are reported of sickness or even loss, especially among lambs admitted to high range too early in the spring. Fleming (35) has artificially fed this plant to calves and sheep, causing poisoning in most cases, and killing one sheep that was fed 8 ounces. Fleming's results have led him to believe that the species varies materially in toxicity in different environments and that there is considerable seasonal change in the poison present. This species appears to be the form figured and described by Glover and Robbins (44, p. 56-57) under the name "American or swamp laurel (*Kalmia polifolia*).\" These authors state that Colorado stockmen generally know very little of swamp laurel as a poisonous plant, probably because it grows only on the very high ranges, where relatively few animals graze. It is much dreaded in some sections, however.



A, Fremont silktassel (*Garrya fremontii*), a shrub ranging from Washington to California, locally used as a quinine substitute and of some value as winter browse. Photograph taken in Matney Gulch, Crater National Forest, Oreg.; B, smooth Labrador-tea (*Ledum glandulosum*), the commonest species of the genus in western United States. It has a history as a sheep-poisoning plant, but is seldom touched by livestock except when palatable (and innocuous) vegetation is absent or scarce

F 197496 F 10253



F165298 F88635 F150609

A, Coast rhododendron (*Rhododendron californicum*), native to the Pacific coast, reputed to be poisonous to sheep, but the herbage is not grazed when sufficient palatable vegetation is present. Photograph taken on the Santiam National Forest, Oreg.; B, big whortleberry (*Vaccinium membranaceum*), one of the commonest and (relatively) most palatable of the western huckleberries. Photograph taken on the Wallowa National Forest, Oreg.; C, red mountain heath (*Phyllodoce empetrifomis*), common in moist sites on high peaks of the far West. Ptarmigan are fond of the flowers. The herbage is normally unpalatable to livestock; if cropped to a considerable extent it causes sickness. Photograph taken on the Deschutes National Forest, Oreg.



FIGURE 37.—Salal (*Gaultheria shallon*), a common shrub of the Pacific coast forests. The herbage is not palatable to livestock, but the purplish berrylike fruits are edible

Bog kalmia, locally known as pale laurel (*K. polifolia*, syns. *K. glauca* and (western form) *K. occidentalis*), ranges in northern or montane bogs from Newfoundland and Labrador to Alaska, northern California, Manitoba, the Great Lakes region, and northern

New Jersey. It is similar to alpine kalmia. This is a rather larger plant than *K. microphylla* (with which it is not infrequently confused), averaging from 6 to 24 inches high. In the Pacific region it is found mainly in the moist coastal belt. Hall and Yates (53) state that this is one of the most poisonous plants occurring in California.



FIGURE 38.—Alpine kalmia or alpine bog kalmia (*Kalmia microphylla*), a dwarf bog shrub of high western mountains, not palatable to livestock, but apt to be poisonous to sheep and calves when eaten by them

LABRADOR-TEAS (LEDUM SPP.)

Labrador-teas, or ledums, comprise some six boreal species, of which three are found in the West. They are evergreen, resinous shrubs, the foliage when bruised having a characteristic fragrance. The genus is essentially one of cold, acid bogs. Livestock (except in Alaska) very seldom touch the foliage of these plants so that, although they are apparently poisonous, relatively few cases of

loss have been attributed to them in the West. It is safest, however, to keep livestock, especially lambs, away from them in early spring.

True Labrador-tea (*L. groenlandicum*) is a species of the far North, occurring in the western United States only in western Washington; it has rusty woolly twigs and lower leaf surfaces and inhabits peaty sphagnum swamps. Its leaves are employed in Greenland and Labrador as a substitute for tea and are also used as a tonic in lung troubles (118). Curiously enough, Hadwen and Palmer (51) rank Alaska tea (this species and *L. palustre*) as among the most important summer reindeer feeds in Alaska, putting them in their first series, Group II, although *Ledum palustre* is ranked low in winter for reindeer, being in the third series (ungrouped).

Crystal-tea (*L. palustre*) is a boreal species, occurring in Alaska and northern Canada, whose leaves and twigs contain the glucoside ericolin ($C_{34}H_{56}O_{21}$) and perhaps the very toxic andromedotoxin as well (95). Lyons (78) states that crystal-tea is reputed to be narcotic, sedative, and insecticide.

Smooth Labrador-tea (*L. glandulosum*) (pl. 9, B) is much the commonest of west-American ledums in the United States, and ranges from British Columbia to California and Wyoming. Chestnut (17) and Jepson (66) have ranked it as a poisonous plant, but Marsh (81) now states that experimental work shows it to be only slightly toxic. Schneider (118) says its leaves are used for killing vermin on cattle and to drive away fleas from country houses.

LEUCOTHOËS (LEUCOTHOË SPP.)

This genus consists of about 30 species occurring in North and South America and in eastern Asia. Four species are found in the Southeastern States and only one in the West. All are evergreen, rather handsome shrubs, with persistent leaves. The characteristic habitat is along streams and in moist woods, but some species are found in swamps.

Black laurel (*L. davisiae*) occurs in the Sierra Nevada of California; while sometimes both local and rare, it is plentiful and abundant in other places. Marsh (81) indicates that it is a virulent species, stating that very small quantities will poison sheep and that death may be produced by 1 or 2 ounces. Hatton (58) states that sheep have to be herded away from it to prevent loss, especially among lambs.

MENZIESIAS (MENZIESIA SPP.)

There are about 7 known species of menziesia, 3 of which occur in the United States and 4 in Japan and northeastern Asia. Of the American species one is confined to the Allegheny Mountains. The two western species are very closely related and many botanists unite them. They are sometimes called fools' huckleberry, minniebush (a corruption of the Latin name), and skunkbush (because of the mephitic odor of the freshly bruised foliage).

Rusty menziesia (*M. ferruginea*), the generic type, has relatively thin and sticky, deciduous leaves which unfold in spring with the flower clusters. It is a plant of moist open woods, and is a common associate of Sitka spruce from Alaska to Oregon along the coast,

also occurring at higher elevations in the mountains inland, in the lodgepole pine, Engelmann spruce, and western larch belts, ranging eastward to the Yellowstone Park region of Wyoming, to western Montana and Alberta.

Smooth menziesia (*M. glabella*) seems to coincide largely in range with *M. ferruginea*, except that its occurrence in Alaska is perhaps questionable, and it probably does not grow west of the Coast Range. Because of the confusion existing in the literature respecting these two species it is difficult, if not impossible, to give their separate ranges with any great accuracy.

All the literature (80, 81, 76) on menziesia poisoning thus far seems to relate to smooth menziesia. Marsh states that menziesia seems not to be a very virulent poison and must be ingested in quantity before serious symptoms ensue. Losses are, as far as known, confined to sheep and are most apt to occur about bed grounds and along trails. The treatment, of course, is one of proper management. Unpublished reports (1916) from the Wenatchee Forest, Wash., state that rusty menziesia is "very plentiful in the higher timbered valleys; not eaten unless sheep are hungry; if eaten in quantity is poisonous." Stockmen of the Santiam National Forest., Oreg., consider it poisonous to their flocks.

MOUNTAIN HEATHS (PHYLLODOCE SPP., SYN. BRYANTHUS SPP.)

The mountain heaths are a small group of 9 northern species, of which about 2 are indigenous to the Alaska region, 3 or 4 others in the Western States, and 1 species in the high mountains of New England and the far North generally. These plants are usually called mountain heathers (3). However, they resemble heaths (*Erica* spp.), having linear leaves, rather than heather (*Calluna vulgaris*) which has imbricated, scalelike leaves. They are small shrubs, with evergreen, hemlocklike or yewlike foliage, and occur in swamps or other moist acid soils. They are largely subalpine or alpine in distribution, being frequently met on steep slopes near the summits or vegetative limits of western peaks. All are ordinarily accounted worthless as forage.

The common species are Brewer mountain heath (*P. breweri*), red mountain heath (*P. empetriformis*) (pl. 10, C), and cream mountain heath (*P. glanduliflora*). Ptarmigan are fond of the flowers of these plants. Red mountain heath is reported by Lenzie sometimes to cause sickness when sheep are forced to eat it in considerable quantity, as along driveways.

RHODODENDRONS (RHODODENDRON SPP.)

Rhododendron is a large, essentially montane or boreal, genus of at least 100 species, excluding the azaleas (*Azalea* spp.) and false-azaleas (*Azaleastrum* spp.), which are merged by some authors with Rhododendron. It is largely Asiatic in distribution, but several species are found in the Eastern States, one in the Western States, and two in Alaska. Honey made from the blossoms of rhododendrons has long been known to have a poisonous effect on the consumer.

Coast rhododendron (*Rhododendron californicum*) (pl. 10, A), known also as California rhododendron and California rosebay, is

the State flower of Washington and is apparently the only true rhododendron known in the Western States. It is a shrub 3 to 12 feet high, or occasionally a small tree about 25 feet high (95, 67), with thick and leathery, evergreen leaves, and occurs in the mountains and along the coast from British Columbia to California (west of the Cascades and Sierra Nevada and chiefly in the coastal region). It is often abundant in peaty acid soils, frequently in those of granitic, basaltic, and serpentine extraction. Coast rhododendron is commonly reported to be poisonous to sheep (17, 95, 67), and Chesnut states that the leaves probably contain the virulently poisonous compound andromedotoxin.

BLUEBERRY FAMILY (VACCINIACEAE)

BLUEBERRIES, WHORTLEBERRIES, AND COWBERRIES (VACCINIUM SPP.)

The blueberry-whortleberry-bilberry genus (*Vaccinium* spp.), including the genera *Cyanococcus* and *Vitis-idaea* of some authors, but excluding the genera or subgenera *Batodendron*, *Oxycoccus*, and *Polycodium*, is a large and widely distributed group of shrubs (occasionally small trees), of which the great majority occur in the Old World. At least 18 species, however, are found in the Western States and a few others are indigenous to the region from Alaska to British Columbia; all are acid-soil plants. As browse they vary from worthless or poor to fair (occasionally fairly good, and rarely good), at least for sheep. In general, the taller species are rather more palatable than the low and sprawling ones, the leaves of the former often tending to be more delicate and succulent. Many of the species are esteemed for their edible berries. Species of *Vaccinium* are popularly and almost universally known in the West as huckleberries, but that term is properly applicable only to *Gaylussacia*, a related, east-American and tropical-American genus.

Big whortleberry (*Vaccinium membranaceum*, syn. *V. macrophyllum*) (pl. 10, B) is a smooth shrub 1 to 5 feet high, with relatively large, thin, and delicate leaves which turn a brilliant scarlet in the fall. It ranges in the high mountains from Alaska to the northern peninsula of Michigan, northern Wyoming, Idaho, and northern California. Local names for it include high (bush), large, and thin-leaf huckleberry, or bilberry.

The species grows on all slopes, but is probably most common on north slopes, frequently occurring in almost pure stands, at elevations from 2,500 to 7,000 feet. It is found in both wet and dry sites, especially in sandy or gravelly loams, is often abundant in or near creek bottoms, both in the open and in dense shade of white fir, hemlock, etc., and is a characteristic species of open burns in the lodgepole type. Frequently associated with big whortleberry are snowbrush, serviceberry, lonicera, mountain-ash, thimbleberry, wild rose, and species of lupine, arnica, and pentstemon. The flowers usually appear from about the middle of May (sometimes earlier) to June, occasionally lasting into July. The good-sized, sweetish, agreeably flavored, almost blackish berries ripen from early or middle August into October, August 20 to September 20 being about the average of maturity.

In general, big whortleberry varies from poor or worthless to fairly good or good for sheep, but is everywhere poor to worthless browse for cattle and horses. Its palatability is materially enhanced when it occurs on sheep range in connection with an ample association of palatable weeds and grass. The species is of chief forage significance in Oregon and in the Snake River drainage of west-central Idaho where many observers rank it as good, or at least fairly good, sheep feed. In Washington Lenzie reports it as fair sheep forage in the fall but at other times and for other livestock worthless to poor. In central Idaho Martineau and Sparhawk state that this shrub appears to be fair sheep browse in early spring, but that it is eaten very little after the middle of July. Considerable variation exists in the times of greatest palatability, but as a rule it is most apt to be grazed either early or late in the season as the sheep are entering or leaving the range. This is one of the most abundant of the western huckleberries and is highly prized as food (27).

Lowbush blueberry (*V. angustifolium*, syns. *V. pennsylvanicum angustifolium*, *V. pennsylvanicum* Lam., not Mill., and *Cyanococcus pennsylvanicus*), is a low warty-branched bush, growing on uplands in dry, rocky or sandy soils. It is an eastern species which gets as far west as Saskatchewan and is of scant forage significance, but is favored as "the early market blueberry."

Dwarf whortleberry (*V. cespitosum*), often called medium or small huckleberry, and dwarf bilberry, is one of the commonest and best known of western huckleberries. It is a low, spreading shrub 3 to 12 inches high, which ranges from Labrador to Alaska and south to California, Colorado, and the highest peaks of New York and New England. Its palatability is very low, often zero, and a detriment to carrying capacity where the species is abundant. A taller form of this species (*V. cespitosum arbuscula*, syn. *V. arbuscula*), sometimes 18 inches high, occurs from Alaska to California, usually growing in rather moist open pine forests; it is found at lower elevations than typical forms of the species, but its palatability seems to be no greater.

Timber-line whortleberry (*V. deliciosum*), a closely related species of about the same stature as dwarf whortleberry, abundant in alpine meadows of the Cascade and Olympic Mountains of Oregon and Washington and famous locally for its fruit, is fair summer sheep browse.

Canada blueberry (*V. canadense*), sometimes called velvetleaf blueberry, another eastern species, a bush 6 to 24 inches high, that gets as far westward as Saskatchewan on moist mountainous sites, is of mediocre forage value.

Western bog blueberry (*V. occidentale*), known also as swamp, or western, blueberry, and swamp huckleberry, is a smooth compact bush 10 to 36 inches high, with small thin leaves, ranging from Montana to southeastern British Columbia, California, and Utah, in moist open meadows or bogs at 4,000 to 10,000 feet, but largely subalpine. This is one of the more palatable browse species of the genus. Although often abundant, it is usually local in distribution and utilizable only when the ground dries out enough for graz-

ing animals to reach it. It is generally considered fair to fairly good sheep and goat feed, especially in the fall, and is appreciably cropped by cattle also in some places.

Rocky Mountain whortleberry (*V. oreophilum*),²⁷ usually known simply as huckleberry, is a low undershrub ranging at high elevations, largely between 8,000 and 11,500 feet in the central Rocky Mountains, from British Columbia to Alberta and northern New Mexico, often occurring in lodgepole pine timber. It is a local but fairly abundant species and, while worthless for cattle, is sometimes fair sheep feed.

Blue whortleberry (*V. ovalifolium*), known also as big, oval-leaf, and tall bilberry, or blueberry, is a large thin-leaved shrub 3 to 12 feet high, growing in both dry and moist woods, in meadows and swamps from Quebec to Michigan, Oregon, Alaska, and Japan, from sea level to about 5,500 feet. In some places it furnishes browse for sheep and goats.

Box blueberry (*V. ovatum*, syn. *Vitis-idaea ovata*), a tall (4 to 8 feet high), stout, thick and evergreen leaved plant, is found near the Pacific from California to Vancouver Island, not infrequently being the dominant element in the understory of redwood and Douglas fir coastal forests from sea level up to about 2,500 feet or so. In some places sheep crop it fairly well, especially in fall, winter, and early spring.

Red whortleberry (*V. parvifolium*) is the largest of the western huckleberries, sometimes reaching a height of 18 feet, and ranges between sea level and about 5,000 feet from Alaska to California west of the Cascades and Sierras. Numerous vernacular names are used for this well-marked species, including red (or tall red) bilberry, blueberry, and huckleberry. It occurs in dry but more commonly in moist conifer woods, often in association with Sitka spruce, Douglas fir, redwood, salal, and box blueberry, reaching its best development in moist spots of the spruce type where there is an accumulation of duff and humus. The leafage is rather scanty, but its thinness and moderate palatability, combined with the slender and delicate twigs, and the fact that the shrub is often very abundant and is frequently associated with decidedly inferior forage plants, give this species some local browse utility for sheep and occasionally for cattle also.

Grouse whortleberry (*V. scoparium*, syns. *V. erythroccum*, *V. myrtillos microphyllum* Hook. (1834), and *V. microphyllum* (Hook.) Rydb., not *V. microphyllum* Reinw. (1826)) is perhaps the most abundant and widespread as well as the smallest and smallest leaved of the western (so-called) huckleberry species. It is known also as dwarf, red, small, and small-leaved huckleberry, and as red alpine blueberry. It ranges from British Columbia to California, northern New Mexico, and Alberta, and is an undershrub 4 to 8 (rarely 12) inches high, with sharply angled, bright-green branches, and small, thin, pale leaves. It has a great altitudinal variation, occurring at least from 2,500 to 12,500 feet, on all slopes. It is found on both dry and moist sites, but is especially characteristic of sandy

²⁷ *Vaccinium myrtillos* of American authors (not L.) is, largely at least, a synonym of this.

or gravelly loams. It is a practically unfailing element of the understory in lodgepole pine stands. The flowering period is usually in June and July, and the fruit ripens from late July to September. Some diversity of opinion exists as to the palatability of grouse whortleberry but it is usually considered worthless to poor and, on the whole, a distinctly inferior browse; in some places in the Blue Mountains of northeastern Oregon and elsewhere it is ranked fair or even fairly good for sheep, despite its small stature and diminutive foliage; but this is due chiefly to its occurrence where there are relatively few palatable species. The species is an important food plant for game birds and other wild life, chiefly because of the bright-red, well-flavored berries.

Mountain cranberry, the American form (var. *minor*) of the typically European cowberry (*V. vitis-idaea*, syn. *Vitis-idaea vitis-idaea*), frequently called foxberry, a low, somewhat creeping, evergreen shrub ranging in rocky open woods from Greenland to Alaska, Alberta, and Massachusetts (also in Europe and Asia) has little if any importance for domestic livestock, but is of some value as winter browse for reindeer and caribou in Alaska (51). Its rather large, red, tart berries (making a first-class jelly) render it an important source of domestic fruit supply in Alaska and elsewhere in the far North, and also of food for bears, migratory birds, and other wild life.

CRANBERRIES (*OXYCOCCUS* SPP.)

Cranberry (*Oxycoccus macrocarpus*, syn. *Vaccinium macrocarpum*), occurs natively from Newfoundland to North Carolina, Arkansas, and Saskatchewan.

Small cranberry (*O. palustris*, syns. *O. oxycoccus* and *V. oxycoccus*), sometimes called European cranberry, grows from Greenland to Alaska and south to Washington, Michigan, and North Carolina, and is also found in Europe and Asia. The variety *O. palustris intermedius* (syns. *O. oxycoccus intermedius*, *O. intermedius*, and *V. oxycoccus intermedium*), sometimes designated as western cranberry, occurs from British Columbia to northern Idaho and western Oregon.

These cranberries are delicate, trailing, almost vinelike, but somewhat woody plants and are typical of cold, peaty, acid bogs. They have no browse utility, but (at least in the case of *O. macrocarpus*) are a valuable commercial crop on account of their berries and of much significance in wild-life conservation as well.

SNOWBELL OR STORAX FAMILY (STYRACACEAE)

There are three eastern species of *Styrax* and one species confined to Texas, but the sole far-western representative of this family is California snowbell (*Styrax californica*, syn. *S. officinalis californica*), a shrub bearing showy white flowers, found in foothills and gravelly woodlands of California from 500 to 4,000 feet. This shrub, also called California storax and snowdrop bush, is not known to be grazed, but further observations as to its palatability are needed. The bark of at least one species of the genus is reputed to be poisonous (128). The species would probably repay a chemical study, Old World snowbells yielding the commercial gums benzoin and storax.

OLIVE FAMILY (OLEACEAE)

ADELIAS (FORESTIERA SPP., SYN. ADELIA)

This genus is represented in the West by about four species, several others occurring in Texas. The palatability of western adelias seems to be low. In general they are poor (rarely fair) late and early cattle browse, but otherwise worthless. It is quite possible that goats crop them to some extent. New Mexican adelia (*Forestiera neomexicana*), called also false, or swamp, privet, ironwood, and tanglebush, is probably the best known of the far-western species. This is usually a smooth shrub 4 to 12 feet high but sometimes a small tree 20 feet tall, ranging in canyons, along stream courses, in parks and browse societies in woodland and semidesert types between 500 and 7,000 feet, from western Texas to central Utah and southern California.

ASHES (FRAXINUS SPP.)

At least 15 species of this chiefly arborescent genus occur in the West. Several of the species have minor importance as browse plants; a number are valued for their wood, as lumber or fuel; about six or seven are cultivated as ornamentals or street trees, and the species of the Southwest often furnish welcome shade to animals during the heat of the day. There is a belief among some stockmen that the ingestion of considerable quantities of ash leaves by domestic animals is apt to cause scours.

Singleleaf ash (*Fraxinus anomala*), known also as dwarf ash, interesting botanically because of its usually simple leaves, is a shrub or small tree occurring in ravines, arroyos, canyons, and on dry rocky hills of the creosote bush and juniper-piñon belts from Nevada to western Colorado and northwestern New Mexico.

Fragrant ash (*F. cuspidata*), locally known as flowering ash and mountain ash, a handsome shrub or low tree with small leaves and showy panicles of white fragrant flowers, occurs usually in fairly moist sites, canyons, and near streams especially, from western Texas to Arizona, Chihuahua, and Coahuila. Both species provide at least poor and sometimes fair to fairly good goat, sheep, and cattle browse, but are hardly abundant enough to have any great significance.

Leatherleaf ash or desert ash (131) (*F. coriacea*, syn. *F. velutina coriacea*), growing occasionally to a tree 40 feet high, is found from Utah to southern California and Arizona in deserts, canyons, along dry watercourses and the like in the creosote bush and sagebrush belts. Its thick, persistent, and almost evergreen foliage gives it some utility as winter, late fall, and early spring browse.

Toumey ash (*F. attenuata*, syns. *F. toumeyi*, *F. velutina toumeyi*) and velvet ash (*F. velutina*, syn. *F. pistaciaefolia*), are two somewhat similar species of the woodland and yellow pine types of the Southwest, having more or less hairy and thickish leaflets. The Toumey ash ranges from New Mexico to Lower California and Chihuahua, and velvet ash, which sometimes appears under the trade name "Arizona ash," occurs from western Texas to southern California and south into northern Mexico. *F. attenuata* and *velutina* are often out of reach of livestock, but, especially *F. velutina*, occasionally have a little local browse utility analogous to that of the related *F. coriacea*.

Oregon ash (*F. oregona*) occurs near streams, in swales and rich alluvial bottom lands, sometimes in gravelly sites, from sea level up to about 5,000 feet, and ranges from southern British Columbia practically throughout California. It is the only Pacific species of ash as far south as northern California and is a valuable timber species on its best sites. The stubbier growths are browsed under some conditions by all classes of livestock. In the Modoc lava-bed country it is a fairly important cattle browse and has been reported as good browse for sheep and goats in Douglas County, Oreg.

MENODORA SPP.

There are approximately six or seven western species of menodora (*Menodora* spp.), sometimes called twinberry or twinfruit, low shrubby or half-shrubby, largely desert perennials of the Southwest and southern Great Basin regions.

Showy menodora (*M. longiflora*, syn. *Menodoropsis longiflora*), an undershrub with large, handsome yellow flowers, is found scattered but rather common, especially on south exposures in oak-mahogany-grama associations of the woodland type, from west Texas to southern New Mexico, and Coahuila, and is fairly palatable goat feed.

Rough menodora (*M. scabra*), an undershrub with flaxlike stems, occurs from west Texas to southern Utah and southern California and south into Mexico, mostly in dry sites up to 7,000 feet.

Smooth menodora (*M. laevis*) of southern New Mexico and Arizona and the closely related rough menodora are accounted fair to fairly good fall, winter, and early spring browse for cattle and horses.

LOGANIA FAMILY (LOGANIACEAE)

BUTTERFLYBUSHES (BUDDLEIA SPP.)

About four species of butterflybush occur in the West, and these are confined to the southern Great Basin and the Southwest. Considerable is yet to be learned concerning their forage and other economic status. As active chemical properties abound in this family, and as a number of the Mexican species are used medicinally (128), it is well to observe these plants carefully on the range.

Woolly butterflybush (*Buddleia marrubifolia*), often called by Mexicans azafan del campo, with rather small leaves, occurs in western Texas and south into Mexico; it is a medicinal plant among Mexicans and Indians and the flowers yield a yellow dye.

Utah butterflybush (*B. utahensis*), with leaves thick, rather narrow, and woolly when young, grows on dry rocky hills and mesas in southwestern Utah and southern Nevada. There is no definite information that either this species or woolly butterflybush is grazed, although it is quite possible that they furnish some browse in the arid sites they inhabit.

Escobilla (*B. scordioides*), also known as golondrilla, a low aromatic bush with small leaves, found in warm dry sites from western Texas to southern Arizona and south to Mexico, is reported to have fairly good to good palatability for sheep, goats, and cattle.

DOGBANE FAMILY (APOCYNACEAE)

LONGTUBES (MACROSIPHONIA SPP.)

Three species of longtube occur in the region from west Texas to southern Arizona.

Arizona longtube (*M. brachysiphon*) grows in dry, sandy, gravelly, or rocky sites, frequently in association with mesquite, at elevations of 2,500 to 5,000 feet, often locally abundant in small dense patches. It is reported as being grazed slightly by cattle and horses in late fall and early spring but otherwise not relished. The showy, very fragrant flowers are prized by Mexicans as a medicine. These are very handsome plants when in full bloom, and they are prolific seeders. As members of a family generally recognized as more or less poisonous they are probably not desirable browse.

PHLOX FAMILY (POLEMONIACEAE)

This large family is predominantly herbaceous. One genus only needs comment here.

LEPTODACTYLON SPP.

The shrubby or semishrubby genus *Leptodactylon*, included by some authors in *Gilia*, embraces about seven or eight species of western undershrubs. They have digitately parted (appearing whorled in some species), often pungent or prickly spiny leaves, and a characteristic musky odor that is agreeable to many people.

Nuttall gilia (*Leptodactylon nuttallii*, syn. *Gilia nuttallii*), perhaps the most widely distributed, common, and best known of these plants, is a showy plant when in full bloom. It occurs in all of the 11 far Western States except possibly Montana. Nuttall gilia, locally known as stickerbush, stinkweed, white gilia, white mountain-weed, and whorl phlox, is sometimes woody throughout, but usually is semiherbaceous, with a woody base and woody, elongated, often thickened taproot; it occurs in meadows, along streams, and on sandy rocky slopes and ridges at 3,500 to 10,500 feet; its forage value is low, often worthless.

Prickly gilia (*L. pungens*, syns. *L. brevifolium* and *Gilia pungens*), locally known as false phlox and prickly sage, is low and sprawling but woody throughout and is also very common and widely distributed, ranging, largely in sagebrush and juniper types, from Montana to Washington, California, and Colorado. It is ordinarily accounted worthless, but, strange to say in view of its small awllike leaves, in certain lava-bed regions (such as parts of northeastern California and southwestern Idaho) it is reliably reported to be fairly good horse, cattle, and sheep feed at least in the spring while the leaves are relatively succulent.

WATERLEAF FAMILY (HYDROPHYLLACEAE)

YERBAS SANTAS (ERIODICTYON SPP.)

Eriodictyon, frequently known as mountain balm, consisting of six or seven species, is a genus confined to the region from southern Oregon to Lower California, Arizona, and southern Utah; only two

species, however, appear to grow outside of California and Lower California, while all seem to be represented there. They are mostly low and leafy, glandular-glutinous or resinous shrubs, and are typical of dry, open, sunny hillsides. At least two of the species have noteworthy medicinal properties but none seem to have any particular grazing value. The two commonest and best known species are discussed here.

California yerba santa (*E. californicum*, syn. *E. glutinosum*) (pl. 11, A) occurs in California and southern Oregon; it is a much-branched bush 1 to 6 feet high, and inhabits dry foothills and lower mountain slopes, often growing in small patches. The species is practically worthless on cattle or sheep range, and only slightly grazed by goats, but is one of the most valuable of the indigenous west-American medicinal plants, and noteworthy as a honey plant and ornamental.

Narrowleaf yerba santa (*E. angustifolium*) ranges from southern Utah to Arizona, southern Nevada, and Lower California, growing on hillsides in rather dry situations from 3,000 to 9,000 feet, though most typical of the creosote bush association (Lower Sonoran Zone) and the piñon belt (Upper Sonoran Zone), usually occurring in scattered patches, and in sandy-gravelly or clayey loams. While sometimes browsed a little, the species is of very little value except perhaps on goat range.

VERBENA FAMILY (VERBENACEAE)

LIPPIAS (LIPPIA SPP.)

Lippia is a genus of shrubs found in the United States and Africa but mainly in Mexico and South America, best known by the familiar cultivated lemon-verbena (*L. citriodora*, syn. *L. triphylla*), native of Chile. There are about four western United States species, all confined to dry, open and sunny, often rocky sites of the Southwest. In addition there are about four western species of the herbaceous fog-fruit genus (*Phyla* spp.), which some authors merge in *Lippia*.

Privet lippia (*L. ligustrina*, syn. *L. lycioides*), known by Mexicans as jaboncillo and other local names, ranging from Texas to southern Arizona and Mexico, is a sometimes spiny-twigged, rather large (4 to 10 feet high) bush, with vanilla-fragrant flowers, and is palatable to cattle, sheep, and goats. Mexicans regard it as medicinal.

Wright lippia (*L. wrightii*), an aromatic, rounded-leaved, silvery-green shrub 2 to 4 feet high, occurs on mesas, rocky slopes, ridges, and canyons, from the covillea to the woodland browse type (between about 3,000 and 7,500 feet) from west Texas to southern Nevada and Mexico. The leaves and flowers have a sweet, sagelike odor. Though scattered, it is common and often locally abundant, and in some places is fair to fairly good sheep, goat, and cattle browse, at least late in the season.

MINT FAMILY (MENTHACEAE)

This huge natural family is represented in the United States, outside of the genera *Hyptis*, *Poliomintha*, *Salazaria*, *Salvia*, and *Sphacele*, almost wholly by herbs.

HYPTIS SPP.

The genus *Hyptis* is primarily Mexican and South American.

Emory bushmint (*Hyptis emoryi*, syns. *H. lanata* and *Mesosphacium emoryi*), also known as bee sage and mountain sage is the only western species, and is further the only shrubby United States species of the genus. It is a lavender-scented, scurfy woolly shrub 3 to 6, rarely 12, feet high, growing on rocky gravelly slopes, ravines, desert valleys, alluvial deposits and the like, mainly in the covillea belt, at 1,500 to 5,000 feet, from Lower California and the Mohave Desert region of southeastern California to south-central Arizona and south into Mexico. It is fair, sometimes fairly good, goat, sheep, and cattle browse.

SAGES AND SALVIAS (SALVIA SPP.)

Sage, in usual western parlance, is a species of the composite genus *Artemisia*. *Salvia*, however, of the mint family, is the genus to which the true sages belong. At least 29 of the true sage species that are found in the West are distinctly shrubby, nearly all of these occurring in California and the Southwest. They are essentially aromatic plants of warm dry sunny foothills and desert regions. A number are rather important secondary browse species, and they are famous honey plants, especially in California, rivaling clover and linden in quality of product (97). At least three of these native western shrubby sages are cultivated as ornamentals.

White sage (*S. apiana*, syns. *Audibertia polystachya* Benth., *Ramona polystachya* (Benth.) Greene, not *S. polystachya* Ortega, of Mexico), known also as bee sage, greasewood, and white bee sage, is a white-leaved, white-flowered shrub 3 to 10 feet high, common and widespread at low elevations in southern California and northern Lower California. It furnishes some winter browse and is one of the chief sages of the apiculturists; the seeds are an important source of food among certain Indian tribes of the region.

Desert sage (*S. carnosa*, syns. *Audibertia incana* Benth., *R. incana* (Benth.) Dougl., *Audibertiella incana* (Benth.) Briq., not *S. incana* Mart. and Gal., of Mexico, *Audibertiella argentea* Rydb., not the cultivated ornamental silver sage, *S. argentea* L., of the Mediterranean region) is often called blue sage. It is much the most widely distributed of all the shrubby western sages and is often common and abundant, ranging at low elevations on dry open plains, largely in covillea, sagebrush, and juniper-piñon types, from Washington to Utah, Arizona, and California. It is a low, spreading bush about 9 to 30 inches high, with showy blue flowers. Its palatability in the Great Basin region is low, but it has some worth on winter range toward the southern limits of its distribution.

Whiteleaf sage (*S. leucophylla*, syns. *Audibertia nivea* Benth., *R. nivea* (Benth.) Briq., not *S. nivea* Thunb., of South Africa) is the common white sage of the apiarists and is also called snowy sage and purple sage.

Black sage (*S. mellifera*, syns. *Audibertia stachyoides* Benth., *R. stachyoides* (Benth.) Briq., not *S. stachyoides* H. B. K., of Mexico), occasionally known also as ball, blue, and button sage, is, according to Pellett (97), the principal source of sage honey and probably the best honey plant of the Pacific Coast. These two sages are exceed-

ingly common foothill shrubs of southern California, not occurring above about 2,500 feet and often forming practically pure stands 3 to 5 feet or so high; they are browsed more or less by sheep and goats.

POTATO FAMILY (SOLANACEAE)

WOLFBERRIES (LYCIUM SPP.)

About 16 valid species of the shrubby, usually more or less spinescent genus *Lycium* occur in the West—mainly on warm dry open plains and foothills of the Southwest. These bushes are common and characteristic and a wealth of vernacular names has been bestowed upon them, including boxthorn, buckbrush, buckthorn, bullberry, chamisa (-o), desert thorn, garambullo, rabbit thorn, squawbush, squawthorn, and tomatilla (-o). A number of these have some forage utility, especially in winter and at other times of food scarcity, such as drought. The berries of many are moderately edible, being eaten by children and often highly prized by Indians, and are an important source of food supply of many animals, especially birds and desert rodents. In addition to the native species, the Old World matrimony-vine (*L. halimifolium*, syn. *L. vulgare*), known also as bastard jessamine (or jasmine), Duke of Argyll's tea-tree, and Jackson vine, with often much elongated, climbing or trailing stems, has widely escaped from cultivation in the United States and occurs in waste places, about settlements, along watercourses, etc., from Ontario to Alberta, Utah, New Mexico, Kansas, and Georgia. Pammel reports (95) that matrimony-vine is reputed to be poisonous, and Lyons (78) states that the roots are medicinal (a diuretic).

Pale wolfberry (*L. pallidum*), probably the most widely distributed species, is a stout, spiny-twigged, widespreading bush 2 to 5 feet high, with large showy flowers, ranging from western Texas to southwestern Colorado, southern Utah, and southeastern California, and south into northern Mexico. It inhabits dry, often alkaline, plains and hills between 5,000 and 8,000 feet elevation, both in clays and in sandy, gravelly, rocky sites, and is apparently more common in the woodland than in the yellow pine type, occurring usually in open grass-brush associations. While a secondary browse species, this shrub is often locally important and valuable, despite the spininess and a palatability which during the growing season is normally not greater than fair or fairly good. It is often common and abundant on areas where there is little other palatable browse, and on winter range it is taken readily by all classes of livestock. The plant is hardy and will withstand considerable abuse, sprouting readily from the base when cut or broken down. Its berries are among the largest and best in the genus.

Frémont wolfberry (*L. fremontii*), a compact rounded bush, 2 to 6 feet high, of Arizona and southeastern California, is dormant during the dry season but furnishes winter browse on desert ranges about Phoenix, Ariz. The species is worthy of further observation as a range plant.

TOBACCOS (NICOTIANA SPP.)

Tree tobacco (*Nicotiana glauca*), known also as coneton, San Juan tree, and tronadora, is the only truly woody species of tobacco growing in the United States. It is a native of South America, but

has widely escaped from cultivation and become well established from western Texas to southern California (occasionally elsewhere northward and eastward, especially in the South) and south into Mexico. The species is an evergreen shrub or small tree 6 to 15 (rarely 20) feet high, occurring in waste places, on banks of streams and irrigation reservoirs, flood plains, etc. Tree tobacco is commonly reputed to be poisonous to cattle and human beings (66, 95, 118, 53, 128), and, in 1915, when feed was short, was reported to have caused the loss of several head of cattle on the Sequoia National Forest, Calif.

FIGWORT FAMILY (SCROPHULARIACEAE)

The vast majority of the United States species of this large family are herbaceous and its western browse value is limited.

BUSH MONKEYFLOWERS (DIPLACUS SPP.)

This showy California genus, united by some botanists with the genus *Mimulus*, consists of about nine species of low to moderate sized bushes with more or less evergreen and viscid foliage, growing for the most part on dry, gravelly, rocky foothills and low ridges. As a group these plants require further study to determine their forage significance; in general, their palatability appears to be low or negligible.

PENTSTEMONS (PENTSTEMON SPP.)

This very large North American genus reaches its best development in the western United States, where it forms one of the most characteristic floral elements in the great majority of the vegetative types from sea level to the limits of plant growth, the species often being locally abundant but confined to relatively small areas (endemic). The species are often called false foxglove, and those with hairy sterile filaments are frequently known as beardtongue. Pennell (98) has called attention to the fact that the original spelling of the generic name is *Penstemon*, and that spelling has now been taken up by some authors. *Pentstemon*, however, does not obscure the etymology and is preferred by most authors. The preponderant tendency of the genus is toward herbaceousness, and yet it comprises an appreciable proportion of undershrubs and of true shrubs as well. The great majority of the herbaceous pentstemons have more or less palatability at least for sheep, but the greater part of the woodier species have either small or leathery leaves and with a few exceptions tend to have low or negligible palatability.

Bush pentstemon (*P. fruticosus*), a woody plant 6 to 24 (rarely 40) inches high, ranging on open rocky slopes, ridges, and rock crevices at 4,000 to 12,000 feet, but largely in subalpine-alpine sites, from southern British Columbia to Oregon and western Wyoming, typifies a group of about 10 undershrubs or low shrubs in the northwestern part of the country, including *Pentstemon barrettae*, *davidsonii*, *douglasii*, *lewisii*, *lyallii*, *menziesii*, *newberryi*, *rupicola*, and *scouleri*. The forage value of bush pentstemon varies from worthless to poor or rarely fair. The other species of this group occur in similar sites and have similar characteristics; their thickish, mostly evergreen leaves have a like palatability and do not enhance

their utility, since the plants occur, of course, on exclusively summer range. In full bloom these species are among the showiest plants of the high mountains and are of interest as being pioneer species on bare granitic rock and the like.

Lemmon pentstemon (*P. lemmonii*) and **Stubflower pentstemon** (*P. breviflorus*) represent a group of bushy and much-branched, distinctly shrubby pentstemons, 1 to 8 feet high, occurring on dry hills or along streams at the lower elevations in California. Both species have a moderate local value as sheep browse, the palatability varying from poor to fair or occasionally fairly good.

Littleleaf pentstemon (*P. microphyllus*) is a bush 3 to 4 feet high confined to central Arizona and occurring chiefly on stream banks and in canyons between about 2,500 and 4,000 feet and often fairly common locally; its palatability for sheep and goats ranges from slight to fairly good, and in drought years and other times of feed scarcity sometimes ranks as good.

TRUMPETCREEPER FAMILY (BIGNONIACEAE)

Desertwillow (*Chilopsis linearis*, syn. *C. saligna*), known locally as false willow and jano, is the only species of its genus. This is a shrub or low tree, 8 to 25 feet high, with willowlike leaves and aspect, occurring on rocky banks of dry or living streams, sandy plains and canyons, borders of deserts, and about seeps and springs, from sea level up to about 5,000 feet. It ranges from western Texas to southern Nevada and southern California and south into Mexico, and is often abundant enough to be one of the chief features of the vegetative landscape. Normally it is unpalatable to livestock, or at best poor; certainly, when it is at all extensively browsed, this is a sure sign of overstocking or severe overgrazing or both. The wood has some local utility for fence posts and in some places it aids in erosion control.

Trumpetbush (*Tecoma stans*, syns. *Bignonia stans*, *Stenolobium stans*, *S. incisum*) is widely distributed in the warmer portions of both North America and South America, the United States range being from Florida to southern Arizona. In the Southwest it is a low, showy bush, about 3 feet high, inhabiting dry rocky hills and sandy gravelly plains, frequently in association with creosote bush, mesquite, and blackbrush. It has no known browse value, but there is some evidence that it has active chemical properties which will probably repay further observation.

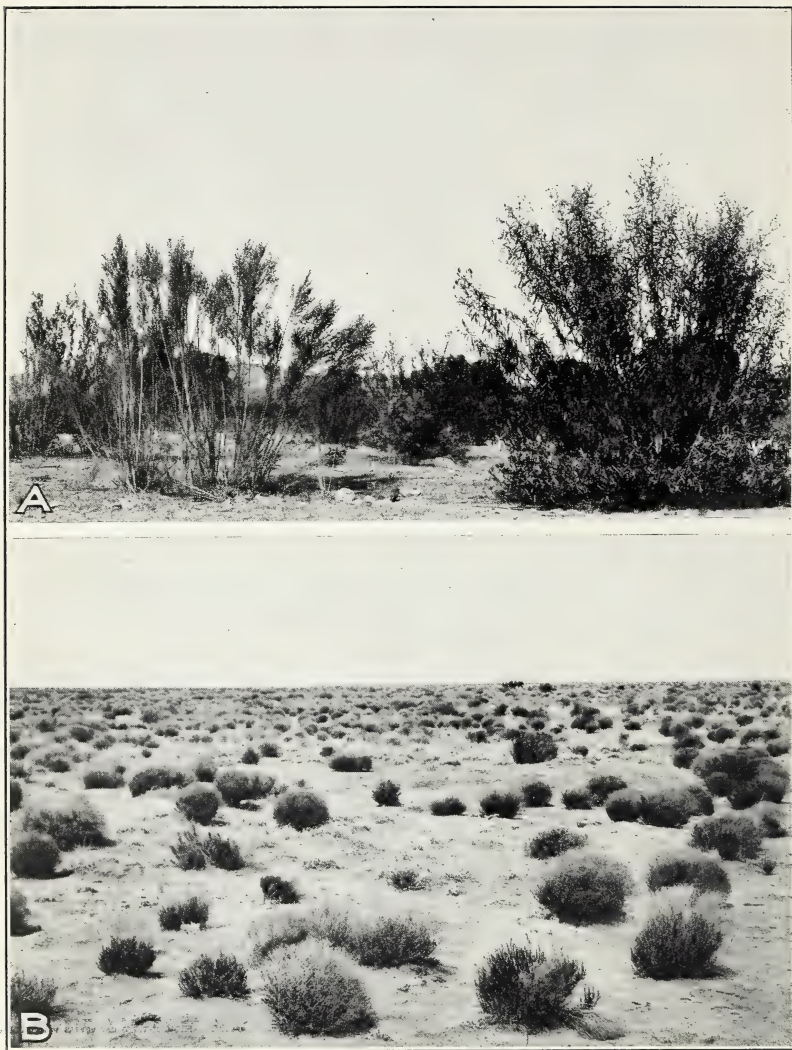
ACANTHUS FAMILY (ACANTHACEAE)

Thurber anisacanth (*Anisacanthus thurberi*, syn. *Drejera thurberi*), a shrubby, usually upright plant, known locally as buckbrush, honeysuckle, and taparosa, grows 1½ to 5 feet high, with thickish, rather narrow leaves 1 inch long (often with smaller ones fascicled in their axils), and attractive, maroon-red flowers, ranges from western Texas to southern New Mexico and Arizona and south into Mexico. It occurs along watercourses, sandy plains, and on dry, gravelly rocky foothill and lower mountain slopes, often in oakbrush types, mostly between 2,500 and 4,500 feet elevation. The palatability of this species ranges from fairly good to very good and



A, California yerba santa (*Eriodictyon californicum*), a shrub often called mountain balm, occurring on dry foothills and lower mountain slopes of southern Oregon and California. It is a valuable medicinal plant but practically worthless as forage except for a slight utility to goats. Photograph taken on the Crater National Forest, Oreg.; B, blackhead elder (*Sambucus melanocarpa*), a common, black-fruited shrub of the western mountains and prized as a fall sheep feed. Photograph taken on the Wallowa National Forest, Oreg.; C, oxytenia (*Orithia acerosa*), a chiefly southwestern shrub normally rejected by grazing animals, and by some cattlemen held to be poisonous.

F 168264 F 33624 F 187544



F162781 F46456A

A, Burrobrush (*Hymenoclea monogyra*) and seepwillow (*Baccharis glutinosa*), Crook National Forest, southeastern Arizona. These two shrubs are important for erosion control in flood plains and along stream channels in the Southwest. Burrobrush is in the left foreground. Seepwillow is in the right foreground and in the middle background; B, rabbit brush (*Crithothamnus* sp.), growing in almost pure stand on the Jornada Range Reserve, N. Mex.

it is often closely browsed by both sheep and cattle especially in the spring. Although common and fairly abundant it usually occurs in rather scattered stand.

Wright anisacanth (*A. wrightii*, syn. *Drejera wrightii*) and **dwarf anisacanth** (*A. insignis*, syn. *A. pumilus* S. Wats., not Nees), two relatively broad-leaved species of this genus, occur in western Texas, the latter extending into extreme southern Arizona and Chihuahua. While palatable to livestock these are not so valuable as is *A. thurberi*.

BELOPERONE SPP.

This tropical American genus is represented in the United States solely by *Beloperone californica*, a rather low shrub of southern California and Lower California occurring mainly about desert springs and seeps, and having spreading branches which usually become practically leafless during the dry seasons. Its palatability is fairly good or good, but it is too limited in abundance and distribution to have more than purely local browse importance. The scarlet, honey-sucklelike flowers make it highly ornamental when in full bloom.

CARLOWRIGHTIA SPP.

This is a Southwestern genus of two almost semiherbaceous undershrubs occurring in dry foothills, plains, and canyons. Heath carlowrightia (*C. linearifolia*) is a smooth heathlike plant, 10 to 36 inches high, with very narrow leaves; it occurs from western Texas to southern Arizona and south into Mexico and is almost worthless as forage. *Carlowrightia arizonica*, confined to Arizona, is very low and widespreading and, while hardly important, is cropped by cattle and sheep to some extent.

MADDER FAMILY (RUBIACEAE)

In dry, sandy gravelly rocky sites at low to medium elevations and largely in grass-weed types, in the region from western Texas to southern Arizona, occur three species of bouvardia (*Bouvardia* spp.). The foliage and delicate stems of these shrubby plants are sometimes nibbled by goats and sheep, but the species usually are local in distribution and not abundant.

Buttonbush (*Cephalanthus occidentalis*), known by a great number of local names, including button tree, button willow, globe-flower, honeyballs, pinball, and snowball, is one of the most widely distributed plants of North America, ranging from New Brunswick to western Ontario, California, and Florida. It occurs on foothills, but its characteristic habitat is along watercourses; it is usually a bush but occasionally becomes a good-sized tree. The large leaves are bitter tasting and unpalatable to livestock and Pammel (95) reports that they contain a poisonous glucoside, cephalanthin. The bitter bark possibly contains active chemical properties (60, 61, 78, 95).

At a conservative estimate about 43 species and 9 varieties of bedstraw (*Galium* spp.), known locally as cleavers, goose grass, and by various other names, are indigenous to the far West. Of these about 9 species are undershrubby or shrubby, the rest being (often weak

and trailing) herbs. In addition several Old World species of the genus (all herbs) are naturalized in the West. Although the herbage of a number of the herbaceous bedstraws is palatable to sheep, the browse value of the genus is almost negligible, the shrubby species having as a rule coarse woody twigs and small, thickish, often prickly-like leaves.

HONEYSUCKLE FAMILY (CAPRIFOLIACEAE)

AMERICAN TWINFLOWER (*LINNAEA BOREALIS* AMERICANA, SYN. *L. AMERICANA* AND *L. BOREALIS* OF AMERICAN AUTHORS NOT (GRONOV.) L.)

This vinelike, trailing, evergreen perennial, hardly more than an herb, with creeping, slender, somewhat woody stems 6 to 24 inches long, is found from Greenland to Alaska and south to California, New Mexico, Michigan, and western Maryland. It is typical of cool, moist, mossy, dense conifer stands, but sometimes occurs in semidry old burns or in willow areas. As a forage plant it is usually negligible, but has been observed to be browsed by sheep in some localities. Its local names include deer vine, ground vine, linnaea, twin sisters, two-eyed berries, and yerba buena.

Sheep herders on the Plumas National Forest, Calif., declare that this plant is very poisonous to sheep, the effect being very similar to that of black laurel but much more severe, the sheep usually dying a few hours after eating it. The plant appears to have no history in toxicological literature. It was submitted in 1914 in a plant collection made on an area of the Colville National Forest, Wash., where sheep poisoning had taken place and where it is reported to be abundant, and later the same year from the Wenaha (now part of the Umatilla) Forest, Oreg., from a supposedly infested area. On neither of these areas was there any proof that this plant was responsible for the losses complained of, and the evidence against the species, while of interest, is purely of the hearsay order.

HONEYSUCKLES (*LONICERA* SPP.)

This is a very large and widely distributed genus of shrubs and woody vines, frequently known as twinberry, and is found chiefly in the temperate portions of the Old World. About 29 species occur in the United States, including the genera *Distegia* and *Xylosteon* of some botanists, of which 9 species are exclusively confined to the Eastern States, 4 are natives of Asia and Europe escaped from cultivation and naturalized, chiefly in the Eastern States, while 16 are indigenous to the West. Ordinarily these plants are unpalatable to livestock, though there is no doubt but that they are sometimes browsed by sheep and, to a less degree, by cattle. Occasionally reports of their poisoning livestock are heard, and Pammel (95) states that "some of the *Loniceras* are possibly poisonous." Schneider (118) states that "the fruit of all species of *Lonicera* is emetic and cathartic." However, birds frequently consume honeysuckle berries.

Bearberry honeysuckle (*L. involucrata*), known also as bearberry, fly honeysuckle, inkberry, involucred honeysuckle, and skunkberry, the range of which, in general, may be stated as New Brunswick

to Alaska, California, Mexico, and the shores of Lake Superior, is probably the commonest and best known of the western honeysuckles. *Distegia involucrata* and *Xylosteon involucratum* are synonyms. *L. ledebourii* (syns. *D. ledebourii*, *X. ledebourii*, and *L. involucrata ledebourii*), a larger form typical of the Pacific coastal region, is also regarded as a synonym by many botanists. It is a freely branching, large-leaved shrub, about 3 to 6 feet high, erect or with the stems somewhat reclining and vinelike, and grows in moist situations, being common along creeks, about springs, in tidelands, and the like, often in association with willows and alders. In the West it is found as high as about 9,000 feet in Colorado and up to about 6,500 or 7,000 feet in the Northwest. In general, this species is worthless for all classes of livestock or else poor for sheep, but in a few regions—such as the Beaverhead of southwestern Montana and the Cache of southern Idaho—it has been observed to be fair or fairly good sheep browse and also slightly cropped by cattle. Pammel (95) quotes Greshoff to the effect that this species contains saponin and intimates that it may be poisonous. Stockmen occasionally report that it has poisoned their animals, especially cattle, but scientific proof is lacking.

Chaparral honeysuckle (*L. interrupta*) occurs on dry, chaparral-clad foothills and ridges of California and Arizona, the stems (except for the short and erect main trunk) clambering and more or less vinelike. In the Modoc lava-bed country Leland S. Smith, reporting its palatability to be zero, states that local stockmen consider the species to be poisonous.

Utah honeysuckle (*L. utahensis*, syn. *Xylosteon utahense*), known locally as big buckbrush, red twinberry, and bush or timber honeysuckle, is a low thin-leaved shrub 2 to 3 (occasionally 5) feet high. It grows in clumps and ranges in the high mountains, being widely distributed in timber types, especially along streams and under partial shade, where the stand is scattered but often abundant. Its palatability usually varies from worthless or almost worthless to low, but in portions of southeastern Idaho it is held to be fairly good sheep browse.

ELDERS (SAMBUCUS SPP.)

Sambucus is a genus of pithy-stemmed shrubs, herbs, or (usually small) trees and embraces about 42 valid species of which perhaps 14 are indigenous to the United States, all but about 3 of these occurring in the Western States. They are often referred to as elderberries, and are typical of moist sites or where subirrigation is present. The herbage, more or less acrid at first and strong scented when bruised, sweetens in fall, especially when the first frost comes, and the browse value of the genus is largely though not entirely confined to the latter part of the season. Elder fruits of a blue or black hue are edible, at least when cooked, and are relished when ripe by birds and other wild life and sometimes by domestic livestock. At least some of the red-fruited species have more or less poisonous fruit, and numerous cases are reported of children and others eating these red berries and becoming ill as a result.

Blueberry elder (*Sambucus caerulea*, syn. *S. glauca*) is ordinarily a many-stemmed bush 6 to 12 feet high, but occasionally it attains

the form of a small tree. It ranges from southern British Columbia to California, Arizona, and Alberta, in foothills, in piñon, and in open yellow pine and aspen, occurring scatteringly in general but commonly along streams, in canyons, and on moist flats and slopes, in sandy or clayey loam, often in association with serviceberry, chokecherry, brome grass, and wheatgrass. In California, where it is the common foothill elder, it occurs from sea level to 5,500 feet (67); in the Northwest (including Idaho), from sea level to about 4,000 feet; and in Utah and Nevada mostly between 5,500 and 9,000 feet.

The copious white flowers, borne in broad, flattened clusters, appear in the mountains from July to early or middle August, but in the foothills and other lower elevations from May to June. The relatively large, sky-blue, berrylike fruits usually begin to ripen about the middle of August and are disseminated from mid-August through October, depending on altitude, latitude, and season.

Blueberry elder is worthless for cattle and worthless to poor browse for sheep in the spring. In the summer its palatability is sometimes fair to fairly good for both sheep and cattle. From the time the berries ripen until after the first frost the palatability rises rapidly, the fruit, foliage, and twigs being eaten; the frosted herbage has good to excellent palatability for sheep and is at least fairly good for cattle. Despite this high palatability in fall, however, this species is frequently handicapped in value by being highly localized or scant in stand and sometimes also by being largely out of reach of grazing animals, especially sheep.

American elder (*S. canadensis*), a good-sized eastern bush, gets as far west as Saskatchewan, Colorado, and western Texas. Its palatability in fall is about equal to that of *S. caerulea*, but as a rule it is not so abundant in the Western States as it is in its more native haunts. The flowers of this species are medicinal (78, 60, 62). The root is highly poisonous.

Mexican elder (*S. mexicana*, syn. *S. canadensis mexicana*), a closely related species with edible fruit and relatively small leaves, is found along river valleys at low elevations from western Texas to southern Arizona and south into Mexico; it is, with the possible exception of *S. caerulea*, the largest western elder, often becoming a good-sized tree well out of reach of livestock.

New Mexican elder (*S. neomexicana*, syn. *S. glauca neomexicana*), **canyon elder** (*S. vestita*), and **velvet (leaf) elder** (*S. velutina*, syn. *S. caerulea velutina*) are other common western blue-black-berried, flat-clustered elders. The *neomexicana* species is found in New Mexico and Colorado in moist to wet sites in the mountains; the *vestita*, a common bush in canyons, in southern New Mexico and Arizona; and the *velutina*, a finely and densely pubescent, rather showy species, in relatively dry foothills and open mountain slopes in California and western Nevada. All of these have limited browse utility.

OTHER SPECIES

On the whole those western species of elder with pyramidal (thyrsoid) flower and fruit clusters (panicles) and, with one exception, red or reddish fruit, are of the greatest forage importance because of their greater number and generally greater range abundance.

Redberry elder (*S. callicarpa*, syn. *S. racemosa callicarpa*; also, fide Piper (99), *S. leiosperma*), a shrub or small tree 8 to 20 feet high, ranging in canyons and coastal flats from British Columbia to California, and highly ornamental when the brilliant scarlet fruit is ripe (about August 15 to September 15), is the largest of these species. In the fall this is considered good sheep and fairly good cattle browse, but it is often either local or inaccessible to livestock.

Blackhead elder (*S. melanocarpa*), known locally as mountain elder(berry), has black fruit, but otherwise its affinities are with the red-berried group of elders. It is a smooth shrub (pl. 11, B) 3 to 10 feet high, ranging from British Columbia to California, New Mexico, and Alberta, inhabiting such sites as stream banks, shaded areas, damp gulches, and other places where snow lies late in the spring, reaching its best development in rich moist loams. It is generally distributed in the yellow pine and Engelmann spruce-lodgepole pine zones, but, while fairly abundant, is seldom a dominant species of the association. In some places it is a fair to fairly good sheep browse and poor to fair summer cattle browse, but in others poor or practically worthless for all classes; after frost, however, the palatability is good, very good, or excellent for sheep and fairly good or good for cattle.

Bunchberry elder (*S. microbotrys*) is one of the smallest and most common of the western elders. It is a smooth shrub, 1½ to 6½ feet high, with a small compact convex cluster of red fruits. Its range is from South Dakota to New Mexico, Arizona, and Nevada, occurring in the mountains in moist canyons, slopes, and table-lands, from the yellow pine type up to subalpine elevations. This is one of the elders that are sometimes rather extensively browsed in summer; in the fall its palatability varies from fairly good to good for cattle and from fairly good to very good for sheep, or sometimes excellent in late fall. Sampson and Weyl employed the species in their plantations against erosion on the Manti Forest (115).

Scarlet elder (*S. pubens*), known also as bore tree, boutry, red-berried elder, and red elderberry, apparently ranges from Newfoundland and Labrador to Alaska, California, Missouri, and Georgia. It is a pubescent shrub 2 to 12 feet high with reddish pith and berries, and usually inhabits moist rocky banks, swamps, ravines, and the like, but sometimes occurs in dry woods, and is often common. It is often confused with the European red elder (*S. racemosa*) from which, however, it is quite distinct. In Washington scarlet elder is found to be worthless as browse until July; from that time its palatability increases until by September or October it is excellent sheep and fairly good cattle browse. These observations doubtless hold true in a general way throughout its western range. The berries are reputed to have a toxic effect on human beings, but are eaten in the fall by sheep with apparent impunity.

SNOWBERRIES AND CORALBERRIES (SYMPHORICARPOS SPP.)

The genus *Symphoricarpos* is confined to North America and consists of about a dozen species, all shrubs, nine of which occur in the Rocky Mountain region. They are sometimes called buckbrush, Indian currant, St. Peter's-wort, waxberry, wolfberry, and other

vernacular names, but the white-berried species are most commonly known as snowberries, and the red-berried ones as coralberries.

Probably all native species of *Symphoricarpos* are grazed to some extent, especially by sheep, cattle, and goats, and some of them are of much range importance particularly in the Great Basin region. Chapline (15) regards them as "of moderately high palatability" for goats and an important source of feed supply for that class of livestock. In the West there is a general tendency for *Symphoricarpos* species to have greater palatability on the eastern and southern ranges than on the western and northern ranges. These shrubs—and especially *S. albus*—are considered by some to be the most important browse plants in Utah, Nevada, and southern Idaho. Since the finding by Greshoff of saponin in the leaves (but not the fruit) of *S. albus* (syn. *S. racemosus*) and *S. mollis* (95) some writers have placed this genus in the group of suspected plants, and Pammel states that cases of poisoning from *S. albus* have been reported from the Old World. However, no case of livestock sickness, let alone loss, appears ever to have been charged to this genus on western ranges; and if saponin be present in western specimens, it is evidently in such small quantity as to be physiologically negligible. A number of the species are in popular cultivation as ornamentals.

Mountain snowberry (*Symphoricarpos oreophilus*) (fig. 39) is frequently called buckbrush, a name indiscriminately applied in the West to a great many different shrubs. Deer brush, Indian currant, and waxberry are also in rather common use for this species. It is a spreading shrub, averaging about 2 to 4 feet high, and ranges from Colorado to New Mexico, California, eastern Oregon, and Idaho.

The species is essentially montane, occurring in Oregon at 4,500 or 5,000 feet elevation, in the Sierra Nevada at 5,000 to 10,000 feet, in the mountains of Colorado and Utah chiefly between 6,500 and 9,500 feet, and in New Mexico and Arizona from about 7,000 to 10,000 feet. It occurs on all slopes and in both moist and fairly dry sites, but usually on sandy or clay loam soils, though sometimes in moist rich black alluvial bottom lands. It is often abundant, sometimes occurs in almost pure stands, and grows in more or less scattered clumps conducive to good utilization by livestock. In Utah and western Colorado, mountain snowberry is probably most familiar as an important component of the aspen type, but elsewhere more often associated with such conifers as western yellow pine, Engelmann spruce, blue spruce, white fir, and Douglas fir. It is seldom found in dense shade, but usually grows in the more open forest, or at the borders of timber surrounding parks and other openings, associated with lupines, various grasses, oaks, chokecherry, and serviceberry.

As browse, mountain snowberry is valuable and often heavily cropped by all classes of livestock and by deer. Relatively its palatability is doubtless inferior to such rosaceous genera as mountain-mahogany (*Cercocarpus*) and the highly palatable species of serviceberry (*Amelanchier*). However, its relatively good palatability, combined with the species' abundance, wide distribution, accessibility, growth form, abundant and ready production of succulent root shoots, large and copious leafage, and excellent powers of reproduction, both sexual and vegetative by underground shoots,



S. oreophilus

FIGURE 39.—Three common western species of snowberry (*Symphoricarpos*): Common snowberry (*S. albus*), mountain snowberry (*S. oreophilus*), and whortleleaf snowberry (*S. vaccinioides*). All are valuable browse plants, and the first two are also in ornamental cultivation

make mountain snowberry one of the important western browse plants.

Common snowberry (*S. albus*, syn. *S. racemosus*) (fig. 39) is the most widely distributed species of the genus, ranging from the

Atlantic to the Pacific and throughout the greater part of Canada and the United States except in the extreme North and in the South-eastern States.

Common snowberry is an important forage species in nearly every portion of the West where it grows. In the interior regions its value ranges from medium to good or very good in the fall for cattle and especially so for sheep; in the Pacific States it is important, at least in late summer and fall. By some this species is ranked as the chief browse plant for sheep in Utah, southern Idaho, and Nevada and one of the most important species for cattle. In California it is usually held in high repute and is eaten down to the ground on overgrazed range. Excessive utilization will kill it out (47, 114). It is one of the relatively few native American shrubs to enter extensively into the horticultural trade and is also much cultivated abroad. It is valued as an ornamental primarily on account of its handsome, waxy, snow-white, round berries.

Spreading snowberry (*S. mollis*) is a low spreading Pacific species, ranging from Washington (and possibly Idaho) to California. In northern California, at least, it is ranked among the foremost local sheep browse plants.

Western snowberry (*S. occidentalis*), a species of wide distribution in the Middle and Far West, is generally held as fair to good winter cattle browse in the North, and in Utah especially it seems to be very palatable to cattle and is termed by stockmen "a strong feed."

Roundleaf snowberry (*S. rotundifolius*), typical of New Mexico and the central and southern Rockies, but extending north to Idaho and west to California, is often common and furnishes fair to good sheep and goat browse.

Whortleleaf snowberry (*S. vaccinoides*) (fig. 39) is typical of the northern Rocky Mountains and occurs from western Montana and southern Alberta to Washington, Nevada, and Colorado. Although its leaves are frequently small and thick and its palatability and value rather inferior to most of the species of the genus, it is often extensively grazed and is regarded, especially in the mountains of Utah, Nevada, and southern Idaho, as a good browse for sheep, goats, and cattle. Marsh, Clawson, and Roe (86) have forcibly fed sheep with the crushed fruit of this shrub, without effect, and conclude that for that class of livestock at least the fruit may be considered harmless.

VIBURNUMS, CRANBERRYBUSHES, AND NANNYBERRY (VIBURNUM SPP.)

Viburnum is a large genus of shrubs and trees found in all four hemispheres. Of the 20 species native to the United States 15 are confined to the eastern and southeastern States, 1 is exclusively western, 2 are transcontinental, and 2 are typically eastern species which extend westward. The genus is typical of the cooler, moister regions, and is both better developed and more abundant toward the north. Only one species (*Viburnum ellipticum*) occurs in California, and the genus appears to be wholly absent from Nevada, Utah, New Mexico, and Arizona. The browse value of the genus

seems to be low, the species not being appreciably grazed unless more desirable forage is absent. A number of the species are in ornamental cultivation.

Nannyberry (*V. lentago*), known also as nannybush, sheepberry, and sweet viburnum, is a shrub or small tree which ranges from Quebec to Manitoba, Colorado, and Georgia; sheep and goats will eat the sweet edible fruits that ripen in September or October.

Rayless cranberrybush (*V. pauciflorum*), so named because of the lack of the enlarged, outer, rayed flowers characteristic of other species, is probably the commonest species of viburnum in the western States. It occurs in cool, moist, shaded areas, especially north slopes, from Newfoundland to Alaska, Oregon, Colorado, and Pennsylvania; it is 2 to 6 feet high and somewhat suggests a currant bush; the foliage has low palatability; the acidulous red fruit is reported to be used by Alaskan natives in making jelly.

American cranberrybush (*V. trilobum*)²⁸ is known also as cramp bark, highbush cranberry, wild guelder-rose, and by many other vernacular names. The familiar snowball of the gardens is a cultivated form with the flowers all neutral, or sterile. This attractive shrub, 3 to 13 feet tall, found from Newfoundland to British Columbia, Oregon, Michigan, and New Jersey, is not known to have material browse significance. The species may, however, have some economic value on western ranges, since its bark is listed in the United States Pharmacopœia (78, 60, 144, 61).

ASTER, OR COMPOSITE, FAMILY (ASTERACEAE, SYN. COMPOSITAE)

Mutisia Subfamily, or Tribe (Mutisieae)²⁹

American trixis (*Trixis californica*, syns., at least in part, *T. angustifolia* of United States authors and *T. suffruticosa*), locally known as red sage and sage, is a leafy, shrubby plant, 1 to 4 feet high, found in deserts and dry, sandy, gravelly, rocky, open sites at low elevations from southwestern Texas to southern California and south into Lower California and Mexico. In many areas it is abundant and widespread and is lightly browsed by cattle during the winter and early spring despite the wormwoodlike odor and taste.

Ragweed Subfamily, or Tribe (Ambrosieae)³⁰

BUR-SAGES (FRANSERIA SPP., SYN. GAERTNERIA MEDIC., NOT GAERTNERA SCHREB.)

Members of this genus are frequently called bur ragweed or ragweed, and, if so, are apt to be confused with the ragweed genus (*Ambrosia* spp.). At least 18 species of *Franseria* occur natively in the United States, chiefly in the Southwest; of these about 10 species are herbs and 8 species more or less shrubby. With one exception the shrubby species of bur-sage are not known to have any particular forage significance. Some of the herbaceous species, such

²⁸ This shrub almost invariably appears in the books under the name either of *Viburnum opulus* L. or else of *V. americanum* Mill. (not *V. opulus americanum* Ait.). According to S. F. Blake, of the Bureau of Plant Industry, who has made a careful study of the matter, the European cranberrybush (*V. opulus*) is a distinct species confined to the Old World; *V. americanum* is an untenable name (the type in the British Museum being *Hydrangea arborescens*!); and *V. trilobum* Marsh. is the oldest tenable name for our American cranberrybush, *V. opulus americanum* Ait. being a synonym thereof.

²⁹ Many authors regard this as a distinct botanical family, Mutisiaceae.

³⁰ This is the family Ambrosiaceae of many authors.

as the common *F. acanthicarpa* and *F. tenuifolia* have a low palatability for cattle and sheep and the former is medicinal among the Zuñi Indians (129).

Triangle bur-sage (*F. deltoidea*, syn. *Gaertneria deltoidea*), sometimes called snakeweed, is a low shrub or undershrub 10 to 24 inches high. Although common in dry foothills and mesas of low elevation in central and southern Arizona, it is worthless as a forage plant.

White bur-sage (*F. dumosa*, syns. *F. albicaulis*, *Gaertneria dumosa*), locally known as burroweed and sand bur, is a low, whitened, brittle-branched, somewhat spiny-twigged bush, ranging from southern California to southwestern Utah and south into Mexico. It is one of the commonest and most abundant desert shrubs of the Southwest, is a frequent associate of creosote bush, and has the characteristic desert habit of leafing and greening out after rains and drying up in the interim. Oddly enough this shrub has quite a local reputation on desert sheep and cattle range, the burlike fruits especially being considered very nutritious and fattening (124), and Coville (26) reports that in the Death Valley region and vicinity the herbage of this species is preferred by horses to that of all other desert shrubs. Palmer (138) ascertained this to be one of the two chief host plants of the curious, parasitic, lennoaceous plant sand-root (*Ammobroma sonorae*), known also as sandfood and camote, whose succulent stems with a flavor reminiscent of sweetpotatoes, are a valuable source of food supply to the Cocopa Indians and to desert travelers.

OTHER GENERA

Burrobrush (*Hymenoclea monogyra*) (pl. 12, A), a diffuse, branched shrub, also known as arrowwood and romerillo, is of chief importance because of its abundance. It is 2 to 6½ feet high, with slender stems and usually fine-dissected leaves, and is found mostly in sandy or gravelly soils along or near streams and in arroyos, canyons, washes, and bottom lands, and to a much lesser extent on mesas and foothills, chiefly in the mesquite-covillea belt, usually at not over 4,500 feet elevation and probably never over 5,500 feet. It often forms dense thickets in deep sand along streambeds where it is valuable in erosion control. Its geographical range is from western Texas to southern California, almost throughout Lower California, and in adjacent Sonora, Sinaloa, and Chihuahua.

The common name "burrobrush" alludes to the usual observation that nothing but burros will eat it. While sometimes extensively cropped on overgrazed range, the foliage of burrobrush is somewhat acrid and usually seems to be unpalatable, and in many places the bush is considered worthless except, to some extent, when growth starts. Bailey (5) compares the white juicy buds and sprouts of this species to fresh, crisp heads of lettuce and states that they are an important source of water and food for desert rodents, especially the kangaroo rat (*Dipodomys merriami*); he estimates the water content of these parts at 90 per cent.

The species may have potential use in artificial planting to control erosion, especially in sandy washes and the like; it seems to be well

adapted for this purpose, being aggressive, hardy, and of relatively rapid growth.

Oxytenia (*Oxytenia acerosa*) is a shrub (pl. 11, C), 3 to 7 feet high, with erect (often leafless and rushlike) branches, and pingue-like leaves. It occurs in dry foothills, canyons, and plains from southwestern Colorado to southeastern California, mostly in clayey, and often alkaline soils. Ordinarily this plant is untouched by livestock. Local stockmen of southwestern Colorado consider it as poisonous to cattle.

Eupatorium Tribe (Eupatorieae)

Carphochaete bigelovii, a low shrub or undershrub, rather showy when in bloom, 4 to 16 inches high, grows in dry sites on hillsides and in canyons of the piñon-juniper belt, from southwestern Texas to Arizona and south into Mexico. It is often locally abundant and, despite the bitter and glandular character of the foliage, is browsed in southern Arizona. The spelling of the generic name "Carpochaete," which has crept into the manuals apparently as a typographical error, is incorrect.

BRICKELLBUSHES (COLEOSANTHUS SPP., SYN. BRICKELLIA)

Coleosanthus (sometimes known as sheathflower) is a genus, consisting of about 92 species, confined to the New World and largely Mexican; 36 of these species occur in the United States, 32 of them inhabiting the far West. Of the western species 20 are shrubs or undershrubs, 8 species are wholly herbaceous and 4 are on the border line between herbs and undershrubs. Despite the number and abundance of these plants, especially toward the south, the American species are rather unimportant forage plants, their palatability being, with perhaps a few exceptions, low, poor, or worthless. Palmer (139) reports that the Lower Californian species *Coleosanthus glabratus* (syns. *Brickellia glabrata*, *B. brachiata* Vasey and Rose, not A. Gray) is very common in parts of that region and is eaten so generally and closely by domestic animals that he could with difficulty collect good botanical specimens of it; Palmer's notes, however, indicate that more or less overgrazing obtained in the areas he refers to.

California brickellbush (*C. californicus*, syns. *Brickellia californica*, *C. albicaulis*, *C. tener*), known also as sage, is an aromatic shrub or undershrub, 2 to 3 feet high, ranging from Lower California to Colorado and south into Mexico, occurring along dry rocky gravelly stream beds and brush-covered foothills and slopes up to about 3,000 feet in California and to about 9,000 feet in Arizona and New Mexico. It is worthless to poor sheep and cattle browse except in winter when it is sometimes fair.

Bigleaf brickellbush (*C. floribundus*, syn. *Brickellia floribunda*), locally known as wild lilac, a large-leaved shrub 2½ to 5 feet high, ranges from southern Arizona and New Mexico to Chihuahua and Sonora, being often abundant, though usually local, in open grassweed types, especially in coarse, gravelly soils. Ordinarily its palatability is low, but in parts of northern New Mexico it is accounted fair feed for both cattle and sheep during the montane grazing season (approximately June–October).

Aster Tribe (Astereae)

GOLDENWEEDS AND THEIR CONGENERS (APLOPAPPUS SPP.)²¹

This large genus, of very diverse habit, has on the whole low palatability; many of the species are worthless unless the range is overgrazed, overstocked, or both; some of the species are more or less poisonous. The United States species of the sections or groups *Pyrrocoma* and *Sideranthus* (syn. *Eriocarpum*) are herbaceous; those of the section *Stenotus* (syn. *Tonestus*) have woody roots and crowns; those of the sections or groups *Chrysoma*, *Ericameria*, *Isocoma*, and *Macronema* are more or less shrubby. Several of the woody western species (e. g., *A. palmeri*, syn. *Ericameria palmeri*, and *A. venetus*, syns. *Bigelovia veneta*, *Isocoma veneta*), have medicinal uses among Indians and Mexicans. A number (e. g., the resinous *A. laricifolius*, syns. *Chrysoma laricifolia* and *Ericameria laricifolia*) are highly ornamental when in full bloom, but none of them are known to be in cultivation. Many are commonly called rayless-goldenrod.

Goldenfleece (*A. arborescens*, syns. *Bigelovia arborescens*, *Chrysoma arborescens*, *Ericameria arborescens*), also called tree rayless-goldenrod, is a common evergreen shrub of California chaparral-covered foothills; while of no grazing value its abundance is noteworthy. Its growth form and height (3 to 15 feet) make it one of the most nearly arborescent of American Compositae. It doubtless is of use in erosion control.

Bloomer rabbit brush (*A. bloomeri*, syn. *Chrysothamnus bloomeri*) is an anomalous species, distinctly of the rabbit brush (*Chrysothamnus*) habit save for its rayed flower heads. It is a fine-leaved shrub, 1 to 2 feet high, which ranges from Washington to Nevada and California, on dry ridges, plains of volcanic ash, and the like, at considerable variations of elevation at least from 3,000 to 10,000 feet; it is locally abundant and is often met with in burns and other openings in timber. It is usually worthless for cattle and horses and low for sheep; mules and burros, however, will sometimes crop it materially. It is most apt to be grazed either in spring or fall.

Jimmyweed (*A. heterophyllus*, syns. *Linosyris heterophyllus*, *Bigelovia wrightii*, *Isocoma wrightii*), often called rabbit brush and rayless-goldenrod, is a half shrub, 1½ to 4 feet high, growing on dry alkaline plains, low foothills, and also along streams and washes, frequently in association with creosote bush, from western Texas to Colorado, Arizona, and south into Mexico. Its taste is bitter-resinous and under normal conditions livestock do not relish it. If forced to graze it, cattle, horses, and sheep are liable to be poisoned, and sometimes killed. It causes what is popularly called alkali disease and milk sickness, resulting in weakness, lassitude, and trembles (133, 87, 68, 88, 81), the symptoms being identical with those of eastern milk sickness caused by white snakeroot or snow thoroughwort (*Eupatorium urticaefolium*, syn. *E. ageratioides*). Moreover, as with *E. urticaefolium*, human beings may contract the disease, by obtaining the toxic compound (tremetol) through drinking the milk of

²¹ Spelled *Haplopappus* by some authors. The commonest synonyms are *Chrysoma*, *Ericameria*, *Eriocarpum*, *Isocoma*, *Macronema*, *Pyrrocoma*, *Sideranthus*, *Stenotus*, and *Tonestus*. *Bigelovia* is partly a synonym.

affected animals. Marsh states that the related *Aplopappus fruticosus* (syns. *Bigelovia coronopifolia*, *Isocoma coronopifolia*, *I. fruticosa*), known as burroweed in southeastern Arizona, and which ranges from western Texas to southern Arizona and Sonora, produces the same harmful effect as *A. heterophyllus*.

Whitestem goldenweed (*A. macronema*, syn. *Macronema discoideum* Nutt. (1840), not *Aplopappus discoideus* DC. (1836)), locally known as yellowbrush, is a white-branched undershrub 4 to 10 inches high, which occurs in gravelly rocky browse sites, at altitudes of 5,000 to 12,000 feet, from Idaho(?) to northern California, Colorado, and western Montana, and is often plentiful. It is appreciably cropped by sheep in some parts of Nevada but, on the whole, its palatability is poor or often nil.

Singlehead goldenweed (*A. suffruticosus*, syn. *Macronema suffruticosum*), also frequently called yellowbrush, ranges from Idaho to Arizona and western Montana, growing on plains and dry open foothills and mountains up to about 9,500 feet. It is a brown-branched undershrub 4 to 12 inches high. While seldom eaten closely, and often not at all, it is an abundant species and, in spring when the vegetation is growing vigorously, and again to some extent in the fall, it is sometimes cropped by sheep. Perhaps specifically indistinguishable from it is *A. linearis*, syn. *Macronema lineare*, an undershrub apparently without an acceptable common name, which occurs in open, sandy gravelly grass-weed types in Montana and Wyoming and which, in the Beaverhead region of southwestern Montana, is reliably reported to be fair to fairly good cattle and fairly good sheep feed in July, probably due to purely local conditions.

ASTERS (ASTER SPP.)

This very large, chiefly North American genus is overwhelmingly herbaceous. There are, however, a relatively very few more or less woody species—notably of the spiny aster section (genus *Linosyris* of some authors) consisting of about three western shrubs or undershrubs worthless for grazing, and the (approximately 10) species of the woody aster section (genus *Xylorrhiza* of some authors) which are found in the region from Wyoming to California and Arizona and vary from scarcely more than herbs, with woody root and crown, to true though low shrubs. The woody asters have a zero to very low palatability and their material cropping by sheep or other livestock is a sure sign of improper range conditions.

Parry aster (*A. parryi*, syn. *Xylorrhiza parryi*), the best known of the woody asters, appears to be confined to Wyoming, mainly in clayey plains at relatively low elevation or in foothills of moderate slope. It attains a height of 4 to 9 inches, with a woody root, a much-branched, woody crown, and woody stem bases. In past years this has been regarded as probably the most disastrous sheep-poisoning plant in Wyoming, the symptoms including weakness, fever, labored breathing, bloat, diuresis, and bloody froth, death ensuing in from a few hours to three or four days (95, 101, 93, 44, 81, 6, 7, 8).

Alkali aster (*A. glabriusculus*, syn. *Xylorrhiza glabriuscula*), somewhat similar to Parry aster, ranging from Wyoming to northeastern Utah mostly in open clayey alkaline plains but sometimes on

rocky hillsides, is commonly regarded by sheepmen adjacent to the Medicine Bow Forest, Wyo., as poisonous.

BACCHARISES AND CONGENERS (BACCHARIS SPP.)

Baccharis is a very large (chiefly South American and Mexican) genus, mainly more or less shrubby, and with the sexes distinct (dioecious). Of the 23 species growing naturally in the United States 16 occur in the far West, chiefly in California and the Southwest. The forage value is worthless or poor and some of the species are known to be poisonous. The coastal *mio mio*, or *nio nio* (*B. coridifolia*) of Atlantic South America contains baccharin, an alkaloid toxic to sheep (144, 95), and Girola (43) states that it causes fatal poisoning to cattle, sheep, goats, and rabbits and that *B. amigdalina* is a suspected species in Argentina.

Yerba-de-pasmo (*B. ramulosa*, syn. *B. pteronioides*) is a low resinous shrub (fig. 40), 10 to 36 inches high, ranging from western Texas to southern Arizona and south into Mexico. The vernacular name alludes to the common use by Indians and Mexicans of an infusion of the leaves as a remedy for chills. It is also frequently known as burroweed, chamisa, chill weed, and winged baccharis. It occurs abundantly but mostly scatteringly on dry, gravelly foothills and plains, chiefly between 3,900 and 6,500 feet, but is occasionally found up to nearly 8,000 feet and usually grows in grass-weed or open oak-brush, covillea, or mountain-mahogany types. Ordinarily the plant is not more than nibbled except on overgrazed or overstocked range when it sometimes causes trouble. C. Dwight Marsh, of the Bureau of Animal Industry, regards this species as probably responsible for serious cattle losses sustained in 1918 and later on the Coronado (Chiricahua) National Forest, Ariz., and the Lincoln Forest, N. Mex., and he states (81) that experimental work has definitely demonstrated that the species is poisonous to sheep, the poisoning taking place in late fall to midwinter.

Emory baccharis (*B. emoryi*), locally known as water moats and water willow, is a shrub, 3 to 12 feet high, ranging from Colorado to California and New Mexico, usually along washes and in coastal or inland flood plains but sometimes in drier, gravelly rocky or clayey soils in open sagebrush-shadscale, juniper, or weed-grass types, often being abundant and well distributed between sea level and 5,500 feet. As a rule it is worthless or else but slightly browsed, but in parts of southeastern Arizona it is appreciably grazed by both cattle and horses from May to December.

Seepwillow (*B. glutinosa*), locally named false, Gila, or water willow, groundsel tree, water motie, and water-wally, is a bush—occasionally only half-shrubby—3 to 12 feet high, with viscid willow-like leaves, and has an enormous distribution from western Texas to Colorado and southern California and south, through Mexico and Central America, to Chile. It is typically a riparian species, growing in scattered clumps or in extensive dense thickets along streams, lake margins, in alluvial plains, canyons, or other moist situations; in such places it is frequently dominant. As a forage plant it is worthless or very poor, but has considerable value in erosion control because of the abundant, tenacious, and both deep and widespread roots.



FIGURE 40.—Yerba-de-pasmo (*Baccharis ramulosa*), an important southwestern poisonous browse and a medicinal plant among Indians and Mexicans: A, Portion of twig with leaf rosettes; B, achene with pappus and persistent corolla; C, D, E, and F, individual leaf variations; G, flowering-fruited spray of pistillate (female) plant

Kidneywort (*B. pilularis*), also known as bush, or seashore groundsel(-tree), chaparral broom, coyote bush, and kidney-root, is a smooth, branching, prostrate-spreading or erect, often galled, evergreen shrub, 6 inches to 5 feet high, ranging from Oregon to southern California. It is typically a coastal or seashore plant, growing (usually in colonies) on dunes and low sand hills, but also occurring inland (though mostly infrequent) in the foothills and mountains up to at least 5,000 feet. It is hardly a forage plant, being at most sparingly goat-grazed but not touched by other livestock. Aside from the therapeutic properties of the roots (78) the species has interest as an aid in the prevention of wind-erosion of dunes.

Broom baccharis (*B. sarothroides*), locally called greasewood and rosin brush, ranges from Lower California and islands to southern California, southwestern New Mexico, and Sonora. The bundle-clustered and broomlike (fastigiata) green stems are 6 to 15 feet high. This frequently abundant and common species occurs along streams, in draws and canyon bottoms, wet alkaline sites, and dry rocky gravelly slopes and washes between 2,000 and 5,000 feet elevation, often in association with mesquite and in open weed-browse-grass types. The herbage has a resinous-bitterish taste and is normally unpalatable to grazing animals. It has been occasionally reported as poisonous in the winter and early spring months at the time that it is most apt to be browsed by cattle and horses, but apparently nothing has yet been published on the subject.

RABBIT BRUSHES (CHRYSOETHAMNUS SPP., SYNS., IN PART, APLOPAPPUS, BIGELOVIA, AND LINOSYRIS)

Chrysothamnus, a shrubby genus of about 70 valid species and perhaps a dozen valid subspecies or varieties confined to western North America, mainly the United States, is one of the most plentiful, widespread, and characteristic groups of woody plants in the West. (Pl. 12, B.)

Rabbit brush is the name probably most commonly applied to this genus in the West and *Chrysothamnus* is probably the genus most commonly called by that name. Rabbitsage, rayless-goldenrod, and yellowbrush are also in frequent use, none very distinctive names.

The average palatability of the species ranges from worthless to fairly good, the chief importance of the genus being its abundance. Some of the species are useful indicators of overgrazing. The browse utility of the rabbit brushes is largely confined to the more arid portions of the Great Basin and its environs. The leaves and upper portions of the lower stalks appear to be the most palatable parts, sheep and cattle taking them mostly in the fall, especially after frosts and when the vegetation is wet from the late rains or the first snowfalls of winter. Sheep have frequently been observed to nip off the flower stalks and, after consuming them, permit the flower heads to drop to the ground in a circle around the plant, leaving the other portions untouched.

Lanceleaf rabbit brush (*C. lanceolatus*, syns. *Bigelovia lanceolata*, *C. viscidiflorus lanceolatus*), sometimes called dwarf yellowbrush, is a woody-based perennial, 8 to 12 (rarely 16) inches high, ranging from Washington to Nevada, Colorado, and Montana, and often abundant on dry plains and slopes. In the Great Basin its

altitudinal distribution is largely from 7,000 to 10,000 feet, the plant frequently growing in association with small needle grass (*Stipa columbiana*, syn. *S. minor*). In central and northern Utah and northern Nevada the leaves of this species are grazed to a limited extent in spring by sheep and cattle, and from about August 15 to winter time the flower stalks are cropped by sheep but the flower heads usually discarded. Farther north and west the species is ordinarily regarded as worthless or else very poor.

Sampson (112) reports this as one of the two primary species of the mixed grass-and-weed type immediately preceding the wheatgrass cover, or subclimax type, in the Wasatch Mountains, and states that it "is the most characteristic forerunner of other aggressive perennial plants which gain a foothold as the wheatgrasses are killed out by overgrazing or other adverse factors." However, as the yellowbrush-needle grass consociation usually has as high (or even higher) a carrying capacity as the subclimax wheatgrass type, at least on common use or sheep range, a good representation of lanceleaf rabbit brush by no means necessarily indicates a deteriorating range.

Rubber rabbit brush (*C. nauseosus*), known also as fetid rayless-goldenrod, rubber yellowbrush, and white sage (brush), is a linear-leaved shrub, 20 to 40 inches high, with the older branches permanently white cottony woolly; it ranges from British Columbia to northern California, Utah, and Alberta, growing in dry, often sandy, gravelly, or rocky open sites (frequently in alkali) at the relatively lower elevations, and is one of the most characteristic components of the sagebrush belt. The herbage of this species has a rubbery, disagreeable flavor, and under normal conditions the palatability ranges from zero to low; the plant is probably a not infrequent indicator of overgrazing. The flowering tops are sometimes taken, however, and on winter range the species is sometimes apparently fair browse because of this fact. A special study has been made of this species by Hall and Goodspeed (52), of the University of California, as a possible source of rubber supply. It has been demonstrated to contain rubber of high grade that vulcanizes readily and which has been named chrysil.

Tall rabbit brush (*C. speciosus*, syns. *C. nauseosus speciosus*, *C. pulcherrimus*), sometimes called showy rabbit brush (fig. 41), is a pale-green, relatively tall species, 20 to 48 inches high, often branched from a trunklike base. It occurs on dry plains and foothills and also in moister sites, such as stream banks, typically from Idaho to Arizona, Colorado, and Montana, but subspecies or varieties extend its range to California and Alberta. It is a very common species and as a rule unpalatable, but in some regions—especially parts of Utah and southern Idaho—it is rather extensively browsed in winter by sheep.

Douglas rabbit brush (*C. viscidiflorus*, syn. *Bigelovia douglasii*), known also as Douglas (or tall) rabbitsage, yellowbrush, and yellow sage, is a species varying greatly both in form and stature; the height ranges from 4 inches to about 7 feet. The species occurs on dry plains and dry rocky, mostly southern exposures, frequently in association with *Artemisia tridentata*, from Washington to Cali-



FIGURE 41.—Tall rabbit brush (*Chrysothamnus speciosus*), a common representative of a familiar western genus. In parts of Utah and southern Idaho it is rather extensively browsed by sheep in winter, but as a rule it is unpalatable or nearly so: C, Fruiting achene with pappus bristles and persistent corolla

fornia (Utah?), and Montana. While ordinarily regarded as worthless this shrub is sometimes grazed when other feed is scarce, and in portions of eastern Oregon it is appreciably cropped by sheep

during fall, winter, and early spring, and limitedly browsed by cattle.

Low rabbit brush (*C. viscidiflorus pumilus*, syns. *C. pumilus*, *Bigelovia douglasii pumila*) one of the smallest members of the genus, occurs abundantly on dry hills and plains of medium elevation in Colorado and Utah and northward and westward to Oregon and Montana. It is considered fair browse in northern Utah and southern Idaho in the fall, both cattle and sheep cropping the flower stalks and leaves.

Sawtooth rabbit brush (*C. viscidiflorus serrulatus*, syns. *C. glaucus*, *C. serrulatus*, *Bigelovia douglasii serrulata*) has a more eastern range than typical forms of the species, occurring from Wyoming to New Mexico and Arizona. It is found on dry plains and slopes at 5,000 to 10,000 feet and Nelson (25) indicates that it never grows in soils containing alkali. It is considered fair browse for both cattle and sheep in spring and fall.

Twistleaf rabbit brush (*C. viscidiflorus tortifolius*, syns. *C. tortifolius*, *Bigelovia douglasii tortifolia*), easily recognized by its contorted leaves, is found in about the same sites as typical forms of the species. In the Uinta Mountains it is commonly held to be fair browse for both sheep and cattle after frost, and in southwestern Utah and the Kaibab Plateau the tops are said to be cropped by cattle to a rather considerable extent.

SLAKEWEEDS (*GUTIERREZIA* SPP.)

Gutierrezia, whose species are frequently known as broomweed, brownweed, matchweed, turpentine-weed, yellow-top, yellow weed, and yerba de vibora, is a New World genus of about 25 species. Ten of the species occur in the United States, all in the West; some of them are herbs, but most are either shrubs or half shrubs with woody roots, crowns, and stem bases.

Broom snakeweed (*G. sarothrae*, syns. *G. diversifolia*, *euthamiae*, *linearis*, *longifolia*, and *tenuis*), by far the commonest and most abundant of these species, ranges from Manitoba to western Nebraska, Kansas, and Texas, southern California, and Idaho, occurring chiefly on well-drained loamy soils in open weed areas at 4,000 to 7,000 feet. This small undershrub is usually considered worthless as forage and, when abundant, as an indicator of overgrazing, but on some areas (notably in Utah and eastern Nevada) it is reputed to be fair browse for cattle and horses in spring and fall, presumably because there is little, if any, better feed available. It seems evident that extensive browsing of this plant is not without serious consequences. Stockmen on the Sitgreaves National Forest, Ariz., state that this species poisons sheep and horses, affecting their kidneys.

Broom snakeweed often comes in heavily after prolonged drought. It is sometimes killed by certain borers and other insects, and in 1924 H. S. Barber and W. S. Fisher, of the Bureau of Entomology, identified certain snakeweed-killing insects submitted from the Jornada Range Reserve, southern New Mexico, as belonging to the genera *Crossidius*, *Diplotaxis*, and *Mecas*. It is possible that to a certain extent artificial control of this range vegetative pest through such insects may some day be practicable.

Threadleaf snakeweed (*G. microcephala*, syn. *G. filifolia*) is a near shrub, woody only on the crown and very stem bases; it ranges from southern Idaho to western Texas and Arizona, occurring on dry plains and foothill and mountain slopes between about 3,500 and 7,500 feet, mainly in bunched growth in the woodland type and on overgrazed grama range. It is unpalatable and seldom observed to be touched by livestock, its increasing abundance on a range being an almost infallible indication of overgrazing. It may possess active chemical properties and perhaps be deleterious; Mrs. Stevenson (129) states that the Zuni Indians steep the flower heads in boiling water and use the tea as a diuretic, sudorific, and tonic, and that their name for the plant, kiahapoko, refers to its being an indicator of the presence of water.

Cudweed Tribe (Gnaphalieae)

Arrowweed (*Pluchea sericea*, syns. *Berthelotia sericea*, *P. borealis*), also known by the vernacular names arrowbush, arrowwood, cachanilla, cachimilla, and osikakamuk, is probably the only western shrub of this group. Arrowweed, whose tall wandlike stems were prized by Indians for making arrows, occurs along streams, in river bottoms and valley lands, largely in brush-annual types from sea level up to 2,500 feet or so, from Lower California to southern Utah and Colorado and western Texas and south into Mexico. It is perhaps the most abundant plant along the lower stretches of the Colorado River. The silvery-hairy herbage is nipped to some extent by cattle and horses.

Sunflower Tribe (Heliantheae)

ENCELIA SPP.

Excluding the herbaceous genera *Enceliopsis*, *Geraea*, and *Simsia*, which some (especially of the older botanists) include in *Encelia*, there are about six valid species and three subspecies, or varieties, of *Encelia* occurring in the western United States, all shrubs, and often known locally as desert sunflower. The browse value is rather low except that cattle and sheep pick off the sunflowerlike flower heads, but animals of any description will very seldom nibble the leaves.

White brittlebush (*E. farinosa*), a name suggested by Hornaday (64) because of the whitish stems and leaves and because the elongated, naked flowering stems become dry and brittle after the seeds mature, is probably the commonest and most familiar species. Other vernacular names include brittlebrush, golden hills, incienso, starchy encelia, tohafs (Pima), and whitebush. Palmer (139) states that Mexicans call it incienso because of the amber-colored, fragrant gum exuded by the plant. In appearance it is a bush 1 to 5 feet high, usually with a short trunk and a broad crown.³² It ranges from Lower California to southern Utah and northern Sonora and is a typical desert plant of the plains and lower foothills, very common

³² Coville (26) has called attention to the fact that annual rings are indistinguishable in the moderately hard wood of the old stems of this species, that the bark is extraordinarily close and compact, and that the leaf hairs are simple and unicellular, whereas those of the related *E. frutescens* (of about the same range) are 3 to 5 celled. Mrs. Shreve has shown (122) that this shrub bears two distinct types of leaves—a mesophytic type in cool months and a xerophytic, matted-hairy type in arid seasons; also (123) that the species has about one-fifth of the transpiration in June that it has in January.

and abundant in dry, warm, rocky situations from sea level to 4,000 feet, and often occurring in almost pure stands or associated with jojoba and *Franseria deltoidea*. The showy flower heads are sometimes taken fairly readily by livestock.

OTHER GENERA

Tar-bush (*Flourensia cernua*), frequently called blackbrush, is a resinous, thick-leaved shrub, 3 to 6 feet high, ranging from western Texas to southern Arizona and Mexico. It is common and abundant on dry sandy, or adobe plains, mesas, and low foothills, frequently in association with creosote bush, mesquite, burrograss, and tobosagrass, often occupying large areas and forming a rather distinctive vegetative type. Unfortunately the herbage has a peppery quality and, unless forced to do so, livestock will not touch it.

Plains blackfoot (*Melampodium leucanthum*), known also as plains melampodium and Easter daisy, which occurs from Kansas to Texas and Arizona and south into Mexico, growing on dry plains and slopes at 2,500 to 7,000 feet, in soils varying from pure sand to rocky or clayey loams, is doubtless the most familiar species of the genus blackfoot. This genus is represented in the Western States by about four indigenous species and about two others naturalized from Mexico; they are herbaceous or somewhat woody perennials. Plains blackfoot is low and about half shrubby; its root and older stem growth are thickened and woody, but the season's stems are slender and herbaceous. The showy flower heads are cropped to some extent by cattle, sheep, and goats, but otherwise the palatability is worthless or low.

Mariola (*Parthenium incanum*), known also as horsebrush, matiola, New Mexican rubberbush, and sage, is a shrubby plant, growing scatteringly but commonly, mostly in the mesquite-covillea type, from extreme western Texas to southern Arizona and south into Mexico. Despite its peculiar taste and its rubber content the tender new shoots and the flower heads are sometimes nibbled by goats, cattle, and sheep. Wootton and Standley (147) indicate that it has been used, but without much practical success, for the production of rubber. Its congener, guayule, or Mexican rubberbush (*P. argentatum*), occurs indigenously as far north as western Texas and produces rubber in commercial quantities; there are cultivated plantations of it in southern Arizona.

Some of the woody species of *Viguiera* (syn. *Gymnolomia*) of the Southwest, such as *V. helianthoides*, *V. parishii*, *V. stenoloba*, *V. tenuifolia*, and *V. texana*, have limited browse utility, especially in southern Arizona and New Mexico. Livestock will frequently pick off the flowering and fruiting heads or, after frost, nibble the leaves. None of these plants seems to have a well-established, distinctive common name; they are usually known locally under the comprehensive term sunflowers.

DOGWEEDS (DYSODIA³³ SPP., SYNS. ACIPHYLLAEA, BOEBERA, HYMENATHERUM, AND, IN PART, THYMOPHYLLA)

Dogweeds, often called fetid-marigolds, comprise a group of about 20 species occurring in the West, mostly in the Southwest; a

³³ Some authors have lately taken up the original spelling, *Dyssodia*. The writer strongly feels that Asa Gray was fully justified in changing the spelling to *Dysodia* (30).

number of these are woody. They have, especially when bruised, a strong pungent odor, pleasant in some species and disagreeable in others. The glandular herbage varies in palatability from worthless to poor.

Prairie dogweed (*D. papposa*, syns. *D. chrysanthemoides*, *Boebera papposa*), also called dog fennel or fetid-marigold, an annual herb now found natively or as an introduced weed in the great majority of the States, is, according to R. F. Copple, fair horse feed in parts of northern New Mexico where stockmen claim it will remove bots from the stomachs of infested animals. *D. papposa* in most places is worthless, or at best poor, as forage and Pammel (95) claims that "it is probably injurious."

Prickleleaf (*D. acerosa*, syns. *Aciphyllaea acerosa*, *Hymenatherum acerosum*), a small, bushy, rather agreeably scented plant 4 to 12 inches high with very fine, glandular, pricklike leaves, thick woody taproot, and branched woody crown, occurs on low dry hills from western Texas to southern Nevada and south into Mexico. It is wholly unpalatable and in some places is abundant enough to become a range pest.

Sneezeweed Tribe (Helenieae)

Damiañita (*Chrysactinia mexicana*), a low, heathlike, profusely branched, aromatic shrub with evergreen, gland-dotted leaves occurs from western Texas to New Mexico and south into Mexico, in brush or grass-browse associations up to the woodland and lower yellow pine types, usually in scattering stand. It is not known to be grazed, but should be closely watched on range where it is common, as it obviously has active properties and is a medicinal plant with Mexicans and Indians. The shrub is often called damiana, but the officinal damiana belongs to the genus *Turnera*.

Yerba-del-venado (*Porophyllum gracile*), sometimes called slender poreleaf, occurs on warm, mostly dry plains at low elevations from Lower California to southern California and western Texas and south into Mexico, and is sometimes very plentiful, especially in sandy situations, such as beaches, dunes, and alluvial strands. It is a bush 6 to 40 inches high, with a strong odor reminiscent of rue or fennel. Despite the astringent properties of the herbage Goldman (45) reports that residents of Lower California state that deer and cattle are very fond of this plant, and Palmer has recorded its medicinal use in that region (139).

Mayweed Tribe (Anthemideae)

SAGEBRUSHES (ARTEMISIA SPP.)

The genus *Artemisia* is a large cosmopolitan group of aromatic herbs and shrubs of both hemispheres, embracing probably about 250 species. The greater part of those in the Western Hemisphere occur in western North America, the center of distribution being in the Rocky Mountain region, to which Rydberg (107), attributes 72 species, 9 being true shrubs, 44 more or less undershrubby, and 19 true herbs.

There seems to be no generally recognized English equivalent of *Artemisia*. In the West, however, these plants are, as a rule, gen-

erally called sage (brush). The names wormwood and mugwort (corruption of midgewort) are also sometimes applied to these plants in this country, as well as abroad. Several Old World artemisias are of economic interest, and a considerable number of them have become naturalized or adventive in parts of the United States.

Big sagebrush (*Artemisia tridentata*), which ranges from western Nebraska to Montana, British Columbia, eastern California, and northern New Mexico, has a wider distribution than most American shrubs and is probably more abundant than any other. The species (fig. 42) is a stout bush, 1 to 15 feet high, with somewhat silvery, narrowly wedge-shaped leaves having usually three triangular teeth at the apex. While found on mountain peaks and high ridges, big sagebrush is essentially a dry-plains plant, where often for great distances it is the chief feature of the landscape. Coville (27), for example, estimates that it composes "probably nine-tenths of the shrubby vegetation of the plains of southeastern Oregon," and this estimate doubtless applies fairly accurately to other portions of the Great Basin having similar ecological conditions. It is most commonly known simply as sage (brush) or common sage (brush). Other vernacular names include black sage, a name derived from the dark bark color of the older stems; Colorado sage (brush), and white sage (brush) referring to the pale leaves.

The altitudinal range of this shrub is considerable, varying in Montana, for example, from 3,300 to 8,300 feet (106) and in Colorado and Utah from about 4,000 to 10,500 feet, but the great mesas or plains at medium elevation or somewhat lower, immediately below the main mountain slopes, are its chief habitat. It is found on all slopes and in a considerable variety of soils, often in those of limestone origin, but rather seldom in granitic soils, though occurring in igneous formations such as disintegrated lavas. This shrub, however, is markedly intolerant of salinity, both in soil and subsoil, as Shantz has pointed out (20, p. 234 and pl. 53), and it attains its most luxuriant growth on deep, rich, moist, alluvial loams.

This shrub is of great importance to the western stockman, covering as it does in abundant stand enormous stretches of readily accessible range. On the higher summer ranges big sagebrush is, where it occurs, seldom of any particular value. On the lower ranges, however, where it is most abundant and where its slender twigs, persistent large leaves, and the flowering or fruiting heads are available to livestock through the late fall, winter, and early spring, the species is often the mainstay ration and is particularly valued at such times for sheep and goats. Cattle browse on the plant considerably during this period, but less so than sheep; horses crop it to some extent. The typical open, rather scattered growth is conducive to optimum utilization, and few if any native western shrub species can surpass this plant in size of total forage crop produced. Livestock, especially sheep, are well known to acquire a "sage hunger," often leaving other feed alone for several days until this craving is appeased.

In general the forage value of big sagebrush increases toward the southern portion of its range, being usually poorly regarded in Washington and much of Oregon, and highly esteemed in Nevada,



FIGURE 42.—Big sagebrush (*Artemisia tridentata*), one of the commonest and most familiar of western plants. It is a valuable browse species on winter range, at least for sheep and goats, and especially toward the south; makes a good fuel; has medicinal properties; and is an important soil and climatic indicator plant. It is the State flower of Nevada: A, Flowering spray; B, spray with fructing heads; C, individual flower head; D, individual leaf

Utah, Colorado, and New Mexico. This is no doubt due in large measure to the fact that in the north the species occurs mostly on summer or early fall range, while the palatability and usefulness is much greater in the late fall, winter, and very early spring. The enormous root system of this shrub enables it to derive water and mineral solutes from a deep and remarkably extensive subterranean area; the species is a fairly rapid grower and practically proof against serious injury from heavy grazing except in winter. The herbage has the peculiar bitter-aromatic quality characteristic of so many species of the genus and is reputed to have tonic properties for livestock.

Big sagebrush has long been valued as an indicator of potential agricultural land, and a vigorous growth of this shrub is of great significance in connection with reclamation projects (119, 102, p. 40-43). Clements (20) states that big sagebrush is the climax plant formation of the Great Basin.

Schneider (118) states that this species is "said to be poisonous," adding that the plant "very likely has diaphoretic and diuretic properties" (144). Coville (27, p. 105) reports that a decoction of the leaves is valuable medicinally to check diarrhea and externally as an eyewash, and calls attention to the fact that the best twirling sticks for fire making amongst the western Indians were made of the wood of this species. Big sagebrush is an important fuel in the region it occupies, igniting readily from the loose stringy bark. This shrub is the State flower of Nevada.

Small sagebrush (*A. nova*, syn. *A. tridentata nova*), otherwise known as dwarf sage (brush), is a little bush 3 to 12 inches high closely related to big sagebrush (*A. tridentata*). It occurs on level plains and on all slopes in the foothills and mountains, mostly in sandy or gravelly loams, and ranges from southern and western Montana to northern New Mexico and Arizona, eastern Nevada, and Idaho, but is perhaps more abundant southward. It occurs from the woodland to the yellow pine types, but is occasionally found in the aspen and spruce belts as well. In parts of Utah, southwestern Colorado, and northern New Mexico, between about 6,000 and 9,000 feet, this species is often one of the most common and abundant undershrubs and is usually held in high repute for both sheep and goats on fall and winter range.

Silver sagebrush (*A. cana*), known also as gray, hoary, silvery, and white sage (brush), is widely distributed from southern Alberta and Saskatchewan to western Nebraska, northern New Mexico, California (east of the Sierra Nevada), and eastern Oregon. It is a grayish-hued, linear-leaved shrub 1 to 10 feet high, and has one of the highest altitudinal ranges in the genus, from 2,500 to 11,500 feet, from sagebrush plains to the Engelmann spruce type. It occurs on all slopes, usually in rather dry sandy or gravelly loams, but is also found on clays and sometimes in moist situations. It usually inhabits grass, park weed, scattered browse, and other open types, and is frequently associated with other species of sagebrush, with yarrow and rabbit brush, and such grasses as blue grama, buffalo grass, June grass, the needle grasses, and the wheatgrasses. Silver sagebrush is abundant on many areas and, while it is usually

of little value for summer grazing, range experts in certain regions, such as southern Wyoming and southern Utah, hold it to be one of the chief local forage species, furnishing fairly good to excellent browse in fall and winter for all classes of livestock. Nelson (92) and Smith (124) regard it as perhaps the best of the forage sagebrushes, stating that it produces much more forage in proportion to the area occupied than the common sagebrush, "due to the production each year of a very large number of long, slender, tender shoots, which are browsed in winter."

Estafiata (*A. frigida*) (fig. 43) is undoubtedly the well-established vernacular name of this species in the Southwest, while pasture sagebrush is probably the name in most general use for the plant toward the North. The Joint Committee on Horticultural Nomenclature (3) recommends the name fringed wormwood. Other names used for the species include American wormwood, budsage, bud wormwood, (Colorado) mountain sagebrush, and (118) sierra salvia.

This species has an enormously wide distribution, ranging from Mexico northward through the western United States and western Canada, into Alaska, and across to Asia and portions of northern Europe. As might be expected from its tremendous range, the forage value of this plant varies considerably in different places. In general, however, it is regarded as one of the best native species of *Artemisia* and is usually considered a good sheep and cattle feed, especially in the fall and winter, though on some ranges it is esteemed as a year-round browse. The abundance and accessibility of the species, combined with its well-developed root system (resistant alike to drought and overgrazing) together with the slender stems and wealth of delicate aromatic leaves and tender buds, give it high rank in the genus.

On the whole the forage value of *estafiata* is deemed greater in the southern portions of its range and lessens toward the north and east. Probably the greater degree of aridity toward the south with the lesser number of succulent plant associates has something to do with this, while undoubtedly its longer use in that region on fall, winter, and spring range plays an important part. In the Southwest it is especially valued on lambing range, where it sometimes occupies the foremost rank.

Estafiata is one of the important sources of winter feed for elk in the Jackson Hole country. Toward the north, however, *estafiata* is apt to be looked on more or less as an indicator of overgrazing, and in a number of places it is held to be quite worthless. For example Sarvis (117) states that in the northern Great Plains about Mandan, N. Dak., "where this plant occurs in abundance it usually will be found that the area has been overstocked for several seasons," and the same author observes that many northern pastures have been totally abandoned where range has been depleted but where this plant is abundant. Thomas P. MacKenzie, commissioner of grazing, department of lands, British Columbia, in correspondence with the Forest Service, strongly intimates that this species, known locally as wormwood, is an indicator of overgrazing in British Columbia, cattle apparently relishing it in the fall only



FIGURE 43.—*Estafiate* (*Artemisia frigida*), an undershrubby species ranging through large portions of the Northern Hemisphere. In the North it is generally regarded as worthless and an indicator of overgrazing, though sometimes a valuable winter elk feed. In the South it is an important feed, at least in fall and winter, and is especially prized on southwestern lambing range: A, Plant, showing rootstocks, branches, and flower heads; B, single leaf; C, individual flower head

when other feed is scarce; he notes a close connection on local ranges between overgrazed conditions and dry cows and raises question as to the possible rôle that *A. frigida* may play in this situation.

Estafiata has been analyzed in the Bureau of Chemistry and Soils, as follows:

	Per cent
Moisture -----	5.31
Ash -----	4.94
Ether extract -----	6.32
Crude fiber -----	32.05
Crude protein -----	9.22
Nitrogen-free extract -----	42.16
Total -----	100.00
Pentosans -----	15.58

If the above analysis is compared with average analyses, say, of alfalfa and timothy hay, estafiata appears rather low in ash and nitrogen-free extract, fair but much below alfalfa in protein, rather high in crude fiber, and high in ether extract. In other words, *Artemisia frigida* is a moderately nutritious feed, and probably one of a more fattening than of a body-building or energy-producing sort.

Estafiata is perhaps our nearest American relative to the Old World common wormwood (*A. absinthium*), from which commercial oil of wormwood and the intoxicant absinthe are derived. Apparently, however, there is no reason for listing our American species as a poisonous plant. Schneider (118) states that this shrub is "much used in the Rocky Mountain region, as a diuretic, diaphoretic and mild cathartic," and that "it perhaps contains a glucoside."

Bud sagebrush (*A. spinescens*, syn. *Picrothamnus desertorum*) is a unique species of the genus variously known as bud brush, bud-sage (the term bud referring to the conspicuous bud or buttonlike, clustered flower heads), button sage (brush), desert sage (brush), horse sage (brush), and spiny sage (brush). It is a low rounded aromatic prickly or spiny twigged shrub or undershrub, about 4 to 20 inches high, occurring in desert habitats of the Great Basin, Southwest, eastern borders of California, southeastern Oregon, and southern Idaho.

Bud sagebrush occurs in neutral, calcareous or somewhat alkaline soil, and probably never grows in acid situations. The dark green delicately dissected foliage, tender young stems, and yellowish buds and inflorescence form an important item in the forage crop of the arid wastes of the regions it typically inhabits. It is about the earliest feed accessible on some of these ranges and is particularly esteemed on lambing grounds and as early sheep feed. W. C. Barnes quotes sheepmen to the effect that bud sagebrush makes the lambs' mouths sore until they get a little hardened to it. It has been noted in the Challis National Forest region of Idaho as high as 5,400 feet, and is there reported to be fairly common on the lower range and a fairly good or good horse browse. In parts of the Wasatch Mountains region it is deemed to be the premier winter sheep forage. The plant has a remarkable root system, and it is almost impossible for drought or overgrazing to kill it out. Aven Nelson (92) regards it as one of the main sheep browses of the Red Desert.

Despite the browse value of this species, above stated, investigations by Fleming (35) indicate that bud sagebrush, if fed in quan-

tity to calves, may, under certain conditions, be sometimes poisonous or even fatal to them. He killed experimentally three yearlings with fresh material of this species by giving each of them quantities varying from $4\frac{1}{2}$ to $6\frac{3}{4}$ pounds; a yearling fed $4\frac{1}{2}$ pounds in one day became sick but recovered; a yearling fed $9\frac{1}{2}$ pounds over a period of six days (one-half to 3 pounds per day) showed no symptoms of poisoning.

SECONDARY SPECIES

Some of our other native western artemisias are worthless, but many species have more or less value for forage. Like *A. tridentata*, these are of most value in the fall, especially after frost, in winter, and in early spring—as on lambing range. They are, moreover, relished especially by sheep, which often seem to have a craving for the peculiar bitterness of the foliage, particularly if there is a great deal of grass or succulent weed feed on the range.

Low sagebrush (*A. arbuscula*), locally known as black sage, is a dwarf bush, 6 to 12 inches high, strongly reminiscent of big sagebrush (*A. tridentata*) except that all the parts are in miniature. It ranges from Idaho to California, Utah, and Wyoming, between elevations of 5,000 and 10,000 feet, and is often common on dry rocky slopes and ridges and in open grass associations of the yellow pine, aspen, and Engelmann spruce types. Sheep, and to a very limited extent cattle, browse this more or less as they are coming onto the range in spring and leaving it in the fall, but owing to the relatively high altitudinal distribution of the species (typically higher than that of *A. tridentata*) and its relatively small leafage, it is not of much range consequence aside from its local abundance.

Bigelow sagebrush (*A. bigelovii*), sometimes called slender gray sage (brush), of the Southwest, is abundant in some localities and is usually regarded as a good spring browse for all classes of livestock but especially relished by sheep.

California sagebrush (*A. californica*), known also as hill brush, old man sage (brush), and California mugwort, is not known to be grazed by range livestock, but is worth careful observation, as it seems to possess active chemical properties, being used by Mexicans as a household remedy, and Schneider (118) states that its leaves and branches have decided insecticide powers.

Carruth sagebrush (*A. carruthii*, syn. *A. kansana*), sometimes called tassel sagebrush, a central, southern, and southwestern semiherbaceous species with delicately dissected foliage, is of good palatability in winter, and fair or fairly good palatability in spring and fall, at least for sheep. It is of especial value in the San Isabel Forest region of Colorado and in parts of northern New Mexico, where it is often abundant and is taken by all classes of livestock.

False tarragon (*A. dracunculoides*, syn. *A. aromatica*) (fig. 44, C, E, F), a widely distributed herbaceous species, is one of the commonest and weediest of western artemisias. Ordinarily it is regarded as worthless or practically worthless, but there are some important exceptions. In southwestern Idaho it is one of the principal sheep forage weeds during the latter part of the season, especially after frost, the spiciform inflorescence or fruiting heads being particularly acceptable. In portions of the Uinta Mountains sheep



FIGURE 44.—Cudweed sagebrush (*Artemisia gnaphalodes*) and false tarragon (*A. dracunculoides*), two common but as a rule not important forage species of *Artemisia*. A and D, Sprays of *A. gnaphalodes*; B, head of *A. gnaphalodes*; C, E, and F, flower head, spray, and rhizome, respectively, of *A. dracunculoides*

crop it well, and in the Fishlake region of south-central Utah, where it occurs scatteringly but widely distributed, it is worthless for cattle but of fairly good palatability on common-use range.

Sand sagebrush (*A. filifolia*), sometimes called threadleaf sagebrush, ranges at relatively low elevations from Nebraska to Wyoming and Mexico; ordinarily it is palatable to livestock and in some places, such as southern Utah, this undershrub is one of the good local forage plants.

Woolly sagebrush (*A. floccosa*), a semiherbaceous species, ranging from Montana to Oregon and Arizona, is in some places common, being usually associated with open stands of yellow pine. In parts of Arizona it is given high rank by the stockmen.

Ragweed sagebrush (*A. franserioides*) is a Southwestern species extending into Mexico. It is a semiherbaceous plant and ordinarily is not esteemed by stockmen; in at least two localities, however, the Cochetopa region of southwestern Colorado and the Santa Fe region of northern New Mexico, it has been pronounced good sheep feed. It is locally in repute for alleged medicinal properties.

Cudweed sagebrush (*A. gnaphalodes*) (fig. 44, A, B, D), a relatively eastern species, is an undershrub extending westward as far as Alberta, eastern Oregon, Utah, and northern New Mexico. As a rule it is absolutely or practically worthless on the range, but there are some exceptions. In parts of the Wind River district of western Wyoming it is held to be a rather valuable browse for both cattle and sheep, and in portions of southwestern Colorado is said to furnish fairly good winter grazing.

Sweet sagebrush (*A. incompta*, syn. *A. discolor incompta*, *A. vulgaris discolor*) is scarcely more than a herbaceous perennial, with a woody, creeping rootstock. It ranges in sagebrush, piñon, and yellow pine types from British Columbia to Utah, Colorado, and Montana. While virtually worthless for cattle, it is often a good sheep feed and in the Great Basin region is to sheep perhaps the most palatable species of the genus.

Louisiana wormwood (*A. ludoviciana*), known also as dark-leaved mugwort, Louisiana mugwort, prairie sagebrush and sweet sage, is a species largely of the Missouri River drainage system, but its range extends westward as far as Oregon and Idaho and southward into Arizona and perhaps into Mexico. In portions of Idaho and Utah, at least, this species is regarded as fair to fairly good feed for sheep in the fall; in some forage associations, however, it is unpalatable to that class of livestock, and as a rule it is almost worthless for cattle. Smith (124) mentions this species favorably, stating that the foliage, though bitter, seems to be nutritious, since sheep are fond of and fatten on it and cattle browse it during the autumn and winter.

Mexican wormwood (*A. mexicana*, syn. *A. silvicola*), known also as Mexican mugwort and Mexican sagebrush, is a silvery-white Mexican species ranging north into Arizona, New Mexico, and western Texas, on the dry ranges of which it is often a plant of importance. Cattlemen often refer to this species as a "cow tonic"; at any rate cattle frequently evince a conspicuous liking for the aromatic, bitterish herbage, especially the younger growth; horses do not always touch it but sheep, particularly on fall and winter range, ordinarily graze it pretty heavily. This species and its ally, New Mexican wormwood, mugwort, or sagebrush (*A. neomexicana*)

are regarded as a potential source of supply for the drug santonin (140); it would appear, therefore, that they should have value in eliminating intestinal worms from livestock and game animals.

Alkali sagebrush (*A. natronensis*) is a species typical of moist to wet shores of alkaline lakes and ponds in eastern Idaho, Wyoming, and adjacent Colorado. It is one of the important winter sheep-browse plants in southeastern Idaho. Some authorities hold it to be a form of *A. longifolia*.

Stiff sagebrush (*A. rigida*) is a low bush found on scab lands and other rocky, mountainous sites in the Northwest. The woody twigs, with their clusters of linear or linearly dissected leaves, simulate somewhat, save for their silvery silky sheen, a spray of piñon or some other short and rigid needled pine. In some places this is a valuable winter browse plant, and ordinarily it is accounted fair sheep forage; it is of especial interest because of a predilection of horses for it (47).

Threetip sagebrush (*A. tripartita*) occurs from Washington to California, Colorado, and Montana. It is a much-branched, silvery-white, fine-leaved shrub, 6 to 48 inches high, and is typical of sunny open park areas, and of sandy gravelly rocky soils, between about 5,000 and 8,000 feet, frequently being an associate of bitterbrush and wild-ryes. In some areas, notably portions of southern Idaho, it is the most abundant species of sagebrush. It is practically worthless as summer browse but is fair sheep feed in very early spring and again in fall, especially after frost; it is of most value when it occurs on winter range.

Wright sagebrush (*A. wrightii*, syn. *A. bakeri*) is a species of the woodland and yellow pine zones of southern Colorado, New Mexico, and eastern Arizona. In Arizona it is usually held to be poor forage save in early spring, when it assumes considerable local importance. In northern New Mexico and contiguous Colorado it is commonly held to be fairly good spring and fall browse for sheep and goats and fairly good or good winter horse and cattle feed.

Groundsel Tribe (Senecioneae)

GROUNDSELS (SENECIO SPP.)

Some of the woody groundsels are limitedly browsed; such are *S. longilobus* (syn. *S. filifolius*) and *S. spartioides* of the Southwest and Middle West. The palatability of these undershrubs is, however, low, especially as compared with some of the herbaceous species of this genus.

HORSEBRUSHES (TETRADYMIA SPP.)

Tetradymia is a group of low, rigid, hoary, sometimes spiny shrubs inhabiting dry sites. The genus is confined to the Western States, consists of about nine species and two subspecies, or varieties, and is chiefly represented in the Great Basin region. Under normal grazing conditions the palatability of horsebrushes is usually nil or else very low except, perhaps, on desert, winter and early spring range.

Littleleaf horsebrush (*Tetradymia glabrata*) is a small-leaved, rather slender-branched shrub, known also as greasewood and spring rabbit brush, 1 to 4 feet high, ranging on dry hills and plains from

Idaho to southeastern Oregon, California (east of the Sierras), and Utah. As a rule the species is not palatable to livestock, but Fleming reports that the buds and young leaves are frequently eaten by sheep in spring in Nevada. When eaten extensively it is apt to prove dangerous to sheep, at least at certain times of the year. The first definite report of this species being poisonous seems to have been an announcement to the press on June 16, 1917, by Doctor Mack, of the Nevada State Veterinary Control Service, to the effect that over 1,000 ewes and about 75 lambs had perished in the stockyards of Reno, May 11-13, 1917, from eating this plant, and that he had administered 4 pounds of the tips of this species to a sheep which died about 45 hours thereafter, the post-mortem examination showing intestinal irritation, internal hemorrhages, dropsy, and degeneration of heart, liver, and kidneys. Fleming and associates (34, 35, 33, 37) state that sheep are the only livestock known to be poisoned by the species; that the poison is a cumulative one; and that sheep must eat a large amount of the plant to be poisoned. Fleming fed four yearling cattle 1 to 8 pounds each of this plant without effect.

Longspine horsebrush (*T. axillaris*, syn. *T. longispina*) (fig. 45), the tallest, longest spined and one of the most abundant species of the genus, occurring from Utah to California and Arizona, chiefly on alkaline low plains and hills, is a range pest.

Nuttall horsebrush (*T. nuttallii*), a sharp, prickly shrub, 1 to 3 feet high, of barren hills in Wyoming and Utah, has (according to Nelson, 92) its soft season's twigs freely nipped off by sheep in the Red Desert of Wyoming.

Shortspine horsebrush (*T. spinosa*), frequently called cotton thorn, another spiny species, with densely white woolly stems, ranges on dry hills, plains, and deserts between 4,000 and 7,000 feet from southern Idaho to eastern California, Utah, and Montana. Nelson states that it forms a valuable constituent of the winter forage for sheep and antelope in the Red Desert.

Spineless horsebrush (*T. canescens inermis*, syn. *T. inermis*) (fig. 45), often called black sage, is an unarmed (spineless) species growing on dry hills and plains, mostly at 4,000 to 9,000 feet, from western Montana to California, and New Mexico; it is probably the most widely distributed and familiar form of the genus. It is usually regarded as worthless or else poor winter feed. In the Modoc lava-bed region of northeastern California it has been reported by Leland S. Smith as poisonous to sheep.

Chicory Subfamily (Cichorieae)³⁴

SKELETONPLANTS (LYGODESMIA SPP.)

This western genus, known also as bundletwigs and prairie pinks, consists of about six more or less herbaceous species, some of them having a woody root and crown and toughened, more or less indurated stems, thus partaking of an undershrubby character. The herbage of these plants is milky juiced and bitter or acrid and the palatability normally is relatively rather low.

³⁴ This is the family Cichoriaceae of many authors.



FIGURE 45.—Longspine horsebrush (*Tetradymia axillaris*), a range pest, and spineless horsebrush (*T. canescens inermis*), a common but worthless and perhaps occasionally injurious western shrub

Rush skeletonplant (*L. juncea*) is hardly more than a perennial herb with a thickened, woody root and base, and tufted stiff rush-like branching stems 4 to 18 inches high. It ranges from Wisconsin to western Texas, Nevada, Idaho, and Saskatchewan, mostly in dry

soils of plains, prairies, and slopes, sometimes occurring up to as high as 12,000 feet in the Rocky Mountains, but usually at the lower elevations. It is often common and abundant and is sometimes a pestiferous weed in grainfields, etc., and is a species whose economic status is still uncertain. The herbage as a rule is distasteful to livestock, but Griffiths (47) states that the species is of some importance as sheep feed on scab lands in Douglas County, Wash. Chesnut and Wilcox (19) report that stockmen in Montana and Utah suspect it of being poisonous, while Schneider (118) speaks of it as a poisonous plant which requires further study. Britton and Brown (14) have called attention to the frequent infestation of this plant with round galls up to five-twelfths of an inch in diameter.

Thorn skeletonplant (*L. spinosa*, syn. *Pleiocanthus spinosus*), sometimes called antelope-brush, locust weed, thorn bush, and other local names, ranges from British Columbia to California, Arizona, and Montana, occurring on sandy, gravelly plains and slopes, rocky ridges, scab lands, and the like, between about 3,000 and 8,000 feet. It is a rigid, spiny, spreading plant 4 to 24 inches high, with a more or less woody crown. While ordinarily worthless or very poor, this plant is grazed to some extent by sheep and cattle when succulent in the spring and again in fall in portions of Nevada and eastern Oregon.

CLASSIFICATION OF WESTERN BROWSE SPECIES BY MISCELLANEOUS USES OR PROPERTIES ³⁵

EDIBLE FRUITS, SEEDS, AND NUTS (EITHER RAW OR COOKED)

Arbutus menziesii, *Arctostaphylos* spp., *Berberis fendleri*, *Castanopsis chrysophylla*, *Corylus californica*, *Gaultheria shallon*, *Grossularia* spp., *Juglans* spp., *Lepargyrea argentea*, *L. canadensis*, *Lycium* spp., *Morus* spp., *Odostemon* spp., *Oleña tesota*, *Opuntia* spp., *Peraphyllum ramosissimum*, *Pinus* spp., *Prosopis* spp., *Prunus* spp., *Rhamnus* spp., *Rhus* spp., *Ribes* spp., *Rubus* spp., *Sambucus* spp., *Simmondsia californica*, *Vaccinium* spp., *Viburnum* spp., *Vitis* spp., *Yucca* spp., *Zizyphus* spp.

LATEX (LAC, RUBBER, SUGAR, ETC.)

Acacia greggii, *Acer* spp., *Amorpha* spp., *Chrysothamnus* spp., *Covillea tridentata*, *Parthenium* spp., *Rhus* spp.

MEDICINAL (BARK, FLOWERS, FRUIT, ROOTS, ETC.)

Adenostoma fasciculatum, *Baccharis pilularis*, *Cassia* spp., *Chimaphila umbellata*, *Cytisus scoparius*, *Eriodictyon californicum*, *Euonymus atropurpureus*, *Fremontodendron californicum*, *Garrya* spp., *Gaultheria* spp., *Ilex verticillata*, *Juniperus communis*, *Myrica* spp., *Odostemon* spp., *Rhamnus purshiana*, *Rubus villosus*, *Sambucus canadensis*, *Umbellularia californica*, *Viburnum* spp.

ORNAMENTALS

Anisacanthus thurberi, *Azalea occidentalis*, *Azaleastrum albiflorum*, *Beloperone californica*, *Calycanthus occidentalis*, *Cassiope* spp., *Ceanothus* spp., *Celastrus* spp., *Celtis* spp., *Clematis* spp., *Cornus nuttallii*, *Crataegus* spp.,

³⁵ The list is suggestive and admittedly incomplete rather than exhaustive. Other miscellaneous uses include those species which are bee plants (such as *Acacia greggii*, *Cephalanthus occidentalis*, and *Salvia mellifera*); species which furnish dyes (such as *Krameria parvifolia*, *Odostemon* spp., and *Ulex europaeus*); those which are of value in planting against erosion (such as *Baccharis glutinosa*, *Grossularia* spp., *Hymenoclea monogyra*, and *Sambucus microbotrys*); and those whose wood is locally prized for fuel (such as *Cercocarpus* and *Prosopis* spp.), for splints (e. g., *Yucca* spp.), for pipe bowls (e. g., *Arctostaphylos* spp.), etc.

Dendromecon spp., *Diervilla lonicera*, *Echinocactus* spp., *Echinocereus* spp., *Edwinia americana*, *Epigaea repens*, *Eriodictyon californicum*, *Fendlera rupicola*, *Leucothoe davisiae*, *Lonicera* spp., *Lycium* spp., *Mammillaria* spp., *Odotemon* spp., *Opulaster* spp., *Opuntia* spp., *Philadelphus* spp., *Phyllodoce* spp., *Rhododendron californicum*, *Ribes* spp., *Robinia* spp., *Rosa* spp., *Sericotheca* spp., *Spiraea* spp., *Styrax californica*, *Symphoricarpos* spp., *Tecoma stans*, *Viburnum* spp.

POISONOUS SPECIES

Aesculus californica, *Aplopappus heterophyllus* (= *Isocoma wrightii*), *Artemisia spinescens*, *Aster parryi* (= *Xylorrhiza parryi*), *Azalea occidentalis*, *Azaleastrum albiflorum*, *Baccharis ramulosa*, *B. sarothroides*, *Calycanthus occidentalis*, *Croton neomexicanus*, *Cytisus scoparius*, *Dendromecon rigida*, *Dodonaea viscosa angustifolia*, *Gutierrezia sarothrae*, *Hypericum* spp., *Kalmia microphylla*, *Ledum glandulosum*, *Leucothoe davisiae*, *Menziesia ferruginea*, *Menziesia glabella*, *Nicotiana glauca*, *Parosela* spp., *Prunus* spp., *Quercus* spp., *Rhododendron californicum*, *Robinia neomexicana*, *Sapindus drummondii*, *Sophora secundiflora* (= *Broussonetia secundiflora*), *Tetradymia glabrata*, *Toxicodendron* spp., *Ungnadia speciosa*.

SOME OUTSTANDING GENERA AND SPECIES OF HABITAT INDICATORS

Alnus spp., *Artemisia incompta*, *Artemisia tridentata*, *Atriplex* spp., *Baccharis* spp., *Betula* spp., *Bumelia* spp., *Chrysothamnus* spp., *Coleogyne ramosissima*, *Covillea tridentata*, *Eurotia* spp., *Gutierrezia* spp., *Hymenoclea monogyra*, *Salix* spp., *Sambucus* spp., *Sarcobatus vermiculatus*.

LITERATURE CITED

- (1) ABRAMS, L.
1923. AN ILLUSTRATED FLORA OF THE PACIFIC STATES, WASHINGTON, OREGON, AND CALIFORNIA. I OPHIOGLOSSACEAE TO ARISTOLOCHIA-CEAE. 557 p., illus.
- (2) ALDOUS, A. E., and SHANTZ, H. L.
1924. TYPES OF VEGETATION IN THE SEMIARID PORTION OF THE UNITED STATES AND THEIR ECONOMIC SIGNIFICANCE. Jour. Agr. Research 28: 99-128, illus.
- (3) AMERICAN JOINT COMMITTEE ON HORTICULTURAL NOMENCLATURE.
1923. STANDARDIZED PLANT NAMES. Prepared by F. L. Olmsted, F. V. Coville, and H. P. Kelsey. 546 p. Salem, Mass.
- (4) BAILEY, L. H.
1914. THE STANDARD CYCLOPEDIA OF HORTICULTURE. [Rewritten, enlarged, and reset.] 6 v., illus. New York.
- (5) BAILEY, V.
1923. SOURCES OF WATER SUPPLY FOR DESERT ANIMALS. Sci. Mo. 17: 66-86, illus.
- (6) BEATH, O. A.
1919. POISONOUS PLANTS. Ann. Meet. Soc. Prom. Agr. Sci.: Proc. 39: 39-47.
- (7) ———
1920. CHEMICAL AND PHARMACOLOGICAL EXAMINATION OF THE WOODY ASTER. Wyo. Agr. Expt. Sta. Bul. 123, p. [41]-66, illus.
- (8) ———
1921. POISONOUS PLANTS OF WYOMING. Wyo. Agr. Expt. Sta. Bul. 126, 35 p., illus.
- (9) BIDWELL, G. L., and WOOTON, E. O.
1925. SALTBUSHES AND THEIR ALLIES IN THE UNITED STATES. U. S. Dept. Agr. Bul. 1345, 40 p., illus.
- (10) BLACK, O. F., and KELLY, J. W.
1927. PSEUDO EPHEDRINE FROM EPHEDRA ALATA. Amer. Jour. Pharm. 99: 748-751.
- (11) BLYTH, A. W.
1884. OLD AND MODERN POISON LORE. Internatl. Health Exhib. London, Gen. Hyg. Lectures, 12: 229-252.

- (12) BRAY, W. L.
1904. THE TIMBER OF THE EDWARDS PLATEAU OF TEXAS; ITS RELATION TO CLIMATE, WATER SUPPLY, AND SOIL. U. S. Dept. Agr., Bur. Forestry Bul. 49, 30 p., illus.
- (13) BREWER, W. H., WATSON, S., and GRAY, A.
1880. BOTANY OF CALIFORNIA. (Polypetalæ, by Brewer and Watson; Gamopetalæ, by Gray.) Ed. 2, 2 v., Cambridge, Mass.
- (14) BRITTON, N. L., and BROWN, A.
1913. AN ILLUSTRATED FLORA OF THE NORTHERN UNITED STATES, CANADA, AND THE BRITISH POSSESSIONS, FROM NEWFOUNDLAND TO THE PARALLEL OF THE SOUTHERN BOUNDARY OF VIRGINIA, AND FROM THE ATLANTIC OCEAN WESTWARD TO THE 102D MERIDIAN. Ed. 2, rev. and enl., 3 v., illus. New York.
- (15) CHAPLINE, W. R.
1919. PRODUCTION OF GOATS ON FAR WESTERN RANGES. U. S. Dept. Agr. Bul. 749, 35 p., illus.
- (16) CHESNUT, V. K.
1898. PRINCIPAL POISONOUS PLANTS OF THE UNITED STATES. U. S. Dept. Agr., Div. Bot. Bul. 20, 60 p., illus.
- (17) ———
1899. PRELIMINARY CATALOGUE OF PLANTS POISONOUS TO STOCK. U. S. Dept. Agr., Bur. Anim. Indus. Ann. Rpt. 1898: 387-420, illus.
- (18) ———
1902. PLANTS USED BY THE INDIANS OF MENDOCINO COUNTY, CALIFORNIA. U. S. Natl. Mus. Contrib. U. S. Natl. Herbarium 7: 295-408, illus.
- (19) ——— and WILCOX, E. V.
1901. THE STOCK-POISONING PLANTS OF MONTANA: A PRELIMINARY REPORT. U. S. Dept. Agr., Div. Bot. Bul. 26, 150 p., illus.
- (20) CLEMENTS, F. E.
1916. PLANT SUCCESSION; AN ANALYSIS OF THE DEVELOPMENT OF VEGETATION. 512 p., illus. Washington, D. C. (Carnegie Inst. Wash. Pub. 242).
- (21) COOK, O. F.
1919. OLNEYA BEANS. A NATIVE FOOD PRODUCT OF THE ARIZONA DESERT, WORTHY OF DOMESTICATION. Jour. Heredity 10: 321-331, illus.
- (22) COTTON, J. S.
1904. A REPORT ON THE RANGE CONDITIONS OF CENTRAL WASHINGTON. Wash. Agr. Expt. Sta. Bul. 60, 45 p., illus.
- (23) COUCH, J. F.
1922. THE TOXIC CONSTITUENT OF GREASEWOOD (SARCOPATUS VERMICULATUS). Amer. Jour. Pharm. 94: 631-641.
- (24) COULTER, J. M.
1891-94. BOTANY OF WESTERN TEXAS. A MANUAL OF THE PHANEROGAMS AND PTERIDOPHYTES OF WESTERN TEXAS. U. S. Natl. Mus. Contrib. U. S. Natl. Herbarium 2, 588 p., illus.
- (25) ———
[1909.] NEW MANUAL OF BOTANY OF THE CENTRAL ROCKY MOUNTAINS. Rev. by A. Nelson, 646 p., New York.
- (26) COVILLE, F. V.
1893. BOTANY OF THE DEATH VALLEY EXPEDITION. A REPORT OF THE BOTANY OF THE EXPEDITION SENT OUT IN 1891 BY THE U. S. DEPARTMENT OF AGRICULTURE TO MAKE A BIOLOGICAL SURVEY OF THE REGION OF DEATH VALLEY, CALIFORNIA. U. S. Natl. Mus. Contrib. U. S. Natl. Herbarium 4, 363 p., illus.
- (27) ———
1897. NOTES ON THE PLANTS USED BY THE KLAMATH INDIANS OF OREGON. U. S. Natl. Mus. Contrib. U. S. Natl. Herbarium 5: 87-108.
- (28) ———
1898. FOREST GROWTH AND SHEEP GRAZING IN THE CASCADE MOUNTAINS OF OREGON. U. S. Dept. Agr., Div. Forestry Bul. 15, 54 p.
- (29) DARROW, G. M., and DETWILER, S. B.
1929. CURRANTS AND GOOSEBERRIES: THEIR CULTURE AND RELATION TO WHITE-PINE BLISTER RUST. U. S. Dept. Agr. Farmers' Bul. 1398, 43 p., illus. (Revised.)

- (30) DAYTON, W. A.
1927. A FEW NOTES ON PLANT NAMES. Biol. Soc. Wash. Proc. 40: 119-121.
- (31) DIETZ, S. M.
1923. THE RÔLE OF THE GENUS RHAMNUS IN THE DISSEMINATION OF CROWN RUST. U. S. Dept. Agr. Bul. 1162, 18 p., illus.
- (32) ———
1926. THE ALTERNATE HOSTS OF CROWN RUST, PUCCINIA CORONATA CORDA. Jour. Agr. Research 33: 953-970, illus.
- (33) DOTEN, S. B.
1922. PROGRESS MADE DURING THE YEAR ON STATION PROJECTS. PROJECT 22. THE PROBLEM OF POISONOUS RANGE PLANTS. Nev. Agr. Expt. Sta. Ann. Rpt. 1921: 10-12, illus.
- (34) FLEMING, C. E.
1918. RANGE PLANTS POISONOUS TO SHEEP AND CATTLE IN NEVADA. Nev. Agr. Expt. Sta. Bul. 95: 1-37, illus. (Spanish translation by B. F. Schappelle, p. [39]-51.)
- (35) ———
1920. DEPARTMENT OF RANGE MANAGEMENT. PROJECT 22. POISONOUS RANGE PLANTS. Nev. Agr. Expt. Sta. Ann. Rpt. 1919: 39-43.
- (36) ——— and DILL, R.
1928. THE POISONING OF SHEEP ON MOUNTAIN GRAZING RANGES IN NEVADA BY THE WESTERN CHOKECHERRY (PRUNUS DEMISSA). Nev. Agr. Expt. Sta. Bul. 110, 14 p., illus.
- (37) ——— MILLER, M. R., and VAWTER, L. R.
1922. THE SPRING RABBIT-BRUSH (TETRADYMIA GLABRATA), A RANGE PLANT POISONOUS TO SHEEP. Nev. Agr. Expt. Sta. Bul. 104, 29 p., illus.
- (38) ——— MILLER, M. R., and VAWTER, L. R.
1926. THE COMMON CHOKECHERRY (PRUNUS DEMISSA) AS A PLANT POISONOUS TO SHEEP AND CATTLE. Nev. Agr. Expt. Sta. Bul. 109, 30 p., illus.
- (39) FLETT, J. B.
1921. FEATURES OF THE FLORA OF MOUNT RAINIER NATIONAL PARK. 48 p., illus. Washington [D. C.] (Dept. Int., Natl. Park Serv.).
- (40) FORBES, R. H.
1895. THE MESQUITE TREE: ITS PRODUCTS AND USES. Ariz. Agr. Expt. Sta. Bul. 13, 26 p.
- (41) FORSLING, C. L.
1919. CHOPPED SOAPWEED AS EMERGENCY FEED FOR CATTLE ON SOUTHWESTERN RANGES. U. S. Dept. Agr. Bul. 745, 20 p., illus.
- (42) FOSTER, L., LANTOW, J. L., and WILSON, C. P.
1921. CHAMIZA AS EMERGENCY FEED FOR RANGE CATTLE. N. Mex. Agr. Expt. Sta. Bul. 125, 29 p., illus.
- (43) GIBOLA, C. D.
1925. PLANTAS TÓXICAS PARA LOS ANIMALES. Argentina Min. Agr. Circ. 472, 19 p., illus.
- (44) GLOVER, G. H., and ROBBINS, W. W.
1915. COLORADO PLANTS INJURIOUS TO LIVESTOCK. Colo. Agr. Expt. Sta. Bul. 211, 74 p., illus.
- (45) GOLDMAN, E. A.
1916. PLANT RECORDS OF AN EXPEDITION TO LOWER CALIFORNIA. U. S. Natl. Mus. Contrib. U. S. Natl. Herbarium 16: 309-371, illus.
- (46) GREENE, E. L.
1891-97. FLORA FRANCISCANA. AN ATTEMPT TO CLASSIFY AND DESCRIBE THE VASCULAR PLANTS OF MIDDLE CALIFORNIA. San Francisco, Calif., 480 p.
- (47) GRIFFITHS, D.
1903. FORAGE CONDITIONS AND PROBLEMS IN EASTERN WASHINGTON, EASTERN OREGON, NORTHEASTERN CALIFORNIA, AND NORTHWESTERN NEVADA. U. S. Dept. Agr., Bur. Plant Indus. Bul. 38, 52 p., illus.
- (48) ———
1904. RANGE INVESTIGATIONS IN ARIZONA. U. S. Dept. Agr., Bur. Plant Indus. Bul. 67, 62 p., illus.

- (49) GRIFFITHS, D.
1920. PRICKLY PEAR AS STOCK FEED. U. S. Dept. Agr. Farmers' Bul. 1072, 24 p., illus.
- (50) ——— and HARE, R. F.
1906. PRICKLY PEAR AND OTHER CACTI AS FOOD FOR STOCK II. N. Mex. Agr. Expt. Sta. Bul. 60, 134 p., illus.
- (51) HADWEN, S., and PALMER, L. J.
1922. REINDEER IN ALASKA. U. S. Dept. Agr. Bul. 1089, 74 p., illus.
- (52) HALL, H. M., and GOODSPEED, T. H.
1919. A RUBBER PLANT SURVEY OF WESTERN NORTH AMERICA. Univ. Cal. Pubs. Bot. 7: 159-278, illus.
- (53) ——— and YATES, H. S.
1915. STOCK POISONING PLANTS OF CALIFORNIA. Calif. Agr. Expt. Sta. Bul. 249, p. 219-247, illus.
- (54) HANSON, H. C.
1923. DISTRIBUTION OF ARIZONA WILD COTTON (THURBERGIA THESPESIODES). Ariz. Agr. Expt. Sta. Tech. Bul. 3, p. [49]-59, illus.
- (55) HARE, R. F.
1908. EXPERIMENTS IN THE DIGESTIBILITY OF PRICKLY PEAR BY CATTLE. N. Mex. Agr. Expt. Sta. Bul. 69, 48 p., illus.
- (56) ——— and GRIFFITHS, D.
1907. THE TUNA AS A FOOD FOR MAN. N. Mex. Agr. Expt. Sta. Bul. 64, 88 p., illus.
- (57) HARSEBERGER, J. W.
1911. PHYTOGEOGRAPHIC SURVEY OF NORTH AMERICA. ... German extract by O. Drude. 790 p., illus. Leipzig and New York.
- (58) HATTON, J. H.
1913. ERADICATION OF CHAPARRAL BY GOAT GRAZING. LASSEN NATIONAL FOREST. U. S. Dept. Agr. Rev. Forest Serv. Invest. 2: 25-28, illus.
- (59) HAVARD, V.
1896. DRINK PLANTS OF THE NORTH AMERICAN INDIANS. Bul. Torrey Bot. Club 23: [33]-46.
- (60) HENKEL, A.
1906. WILD MEDICINAL PLANTS OF THE UNITED STATES. U. S. Dept. Agr., Bur. Plant Indus. Bul. 89, 76 p.
- (61) ———
1909. AMERICAN MEDICINAL BARKS. U. S. Dept. Agr., Bur. Plant Indus. Bul. 139, 59 p., illus.
- (62) ———
1913. AMERICAN MEDICINAL FLOWERS, FRUITS, AND SEEDS. U. S. Dept. Agr. Bul. 26, 16 p., illus.
- (63) HILL, R. R.
1917. EFFECTS OF GRAZING UPON WESTERN YELLOW-PINE REPRODUCTION IN THE NATIONAL FORESTS OF ARIZONA AND NEW MEXICO. U. S. Dept. Agr. Bul. 580, 27 p., illus.
- (64) HORNADAY, W. T.
1908. CAMP-FIRES ON DESERT AND LAVA. 366 p., illus. New York.
- (65) JEPSON, W. L.
1909-22. A FLORA OF CALIFORNIA. Pt. 1-7, illus. San Francisco.
- (66) ———
1911. A FLORA OF WESTERN MIDDLE CALIFORNIA. Ed. 2, 515 p. San Francisco.
- (67) ———
[1925] A MANUAL OF THE FLOWERING PLANTS OF CALIFORNIA. 1,238 p., illus. Berkeley, Calif.
- (68) JOHNSON, E. P., and ARCHER, W. A.
1922. THE PRINCIPAL STOCK-POISONING PLANTS OF NEW MEXICO. N. Mex. Agr. Expt. Sta. Ext. Circ. 71, 40 p., illus.
- (69) JOHNSTON, I. M.
1924. TAXONOMIC RECORDS CONCERNING AMERICAN SPERMATOPHYTES. Harvard Univ. Contrib. Gray Herbarium (n. s.) 70: 61-92.
- (70) JONES, J. M., and CONNER, A. B.
1918. THE UTILIZATION OF YUCCA FOR THE MAINTENANCE OF CATTLE. Tex. Agr. Expt. Sta. Bul. 240, 23 p., illus.

- (71) JUDD, C. S.
1922. THE TESOTA BEAN TREE—A NEW INTRODUCTION. Hawaii Forester and Agr. 19:224.
- (72) KEELER, H. L.
1903. OUR NORTHERN SHRUBS AND HOW TO IDENTIFY THEM; A HANDBOOK FOR THE NATURE-LOVER. 521 p., illus. New York.
- (73) KELLOGG, R. S.
1922. USES OF MESQUITE. [Letter to editor of Lumber.] Lumber 69 (923):16.
- (74) KNIGHT, H. G., HEPNER, F. E., and NELSON, A.
1905. WYOMING FORAGE PLANTS AND THEIR CHEMICAL COMPOSITION—STUDIES NO. 1. Wyo. Agr. Expt. Sta. Bul. 65, 52 p., illus.
- (75) KUNZÉ, R. E.
1903. THE DESERT FLORA OF PHOENIX, ARIZONA. Bul. Torrey Bot. Club. 30:302-307.
- (76) LAWRENCE, W. E.
1922. THE PRINCIPAL STOCK-POISONING PLANTS OF OREGON. Oreg. Agr. Expt. Sta. Bul. 187, 42 p., illus.
- (77) LONG, H. C.
1917. PLANTS POISONOUS TO LIVESTOCK. 119 p., illus. Cambridge, England.
- (78) LYONS, A. B.
1900. PLANT NAMES SCIENTIFIC AND POPULAR . . . 489 p. Detroit, Mich.
- (79) MACKIE, W. W.
1903. THE VALUE OF OAK LEAVES FOR FORAGE. Calif. Agr. Expt. Sta. Bul. 150, 21 p., illus.
- (80) MARSH, C. D.
1914. MENZIESIA, A NEW STOCK-POISONING PLANT OF THE NORTHWESTERN STATES. U. S. Dept. Agr., Bur. Plant Indus. Circ. 3 p., illus.
- (81) ———
1929. STOCK-POISONING PLANTS OF THE RANGE. U. S. Dept. Agr. Bul. 1245, 75 p., illus. (Revised.)
- (82) ———
1929. TREMBLES. U. S. Dept. Agr. Farmers' Bul. 1593, 10 p., illus.
- (83) ———
CLAWSON, A. B., and COUCH, J. F.
1923. GREASEWOOD AS A POISONOUS PLANT. U. S. Dept. Agr. Circ. 279, 4 p., illus.
- (84) ———
CLAWSON, A. B., and MARSH, H.
1919. OAK-LEAF POISONING OF DOMESTIC ANIMALS. U. S. Dept. Agr. Bul. 767, 36 p., illus.
- (85) ———
CLAWSON, A. B., and ROE, G. C.
1928. COYOTILLO (KARWINSKIA HUMBERTIANA) AS A POISONOUS PLANT. U. S. Dept. Agr. Tech. Bul. 29, 27 p., illus.
- (86) ———
CLAWSON, A. B., and ROE, G. C.
1928. FOUR SPECIES OF RANGE PLANTS NOT POISONOUS TO LIVESTOCK. U. S. Dept. Agr. Tech. Bul. 93, 10 p.
- (87) ———
and ROE, G. C.
1921. THE "ALKALI DISEASE" OF LIVESTOCK IN THE PECOS VALLEY. U. S. Dept. Agr. Circ. 180, 8 p., illus.
- (88) ———
ROE, G. C., and CLAWSON, A. B.
1926. RAYLESS GOLDENROD (APLOPAPPUS HETEROPHYLLUS) AS A POISONOUS PLANT. U. S. Dept. Agr. Bul. 1391, 24 p., illus.
- (89) MERRILL, R. E.
1923. PLANTS USED IN BASKETRY BY THE CALIFORNIA INDIANS. Calif. Univ. Pubs. in Amer. Archeol. and Ethnol. 20: [215]-242, illus.
- (90) MORSE, F. W., and HOWARD, C. D.
1898. POISONOUS PROPERTIES OF WILD CHERRY LEAVES. N. H. Agr. Expt. Sta. Bul. 56, [112]-123 p., illus.
- (91) MUNNS, E. N.
1922. BEAR CLOVER AND FOREST REPRODUCTION. Jour. Forestry 20:745-754, illus.
- (92) NELSON, A.
1898. THE RED DESERT OF WYOMING AND ITS FORAGE RESOURCES. U. S. Dept. Agr., Div. Agrost. Bul. 13, 72 p., illus.
- (93) ———
and KNIGHT, H. G.
1913. THE IDENTIFICATION OF THE WOODY ASTER. Wyo. Agr. Expt. Sta. Bul. 97, [3] p., illus.

- (94) NELSON, E.
1904. NATIVE AND INTRODUCED SALTBUSHES, THREE SEASONS' TRIALS. Wyo. Agr. Expt. Sta. Bul. 63, 19 p., illus.
- (95) PAMMEL, L. H.
1910. A MANUAL OF POISONOUS PLANTS, CHIEFLY OF EASTERN NORTH AMERICA, WITH BRIEF NOTES ON ECONOMIC AND MEDICINAL PLANTS . . . 2 v., illus. Cedar Rapids, Iowa.
- (96) ———
1913. POISONOUS PLANTS OF THE RANGE. Ames Forester 1: 33-43, illus.
- (97) PELLETT, F. C.
1920. AMERICAN HONEY PLANTS, TOGETHER WITH THOSE WHICH ARE OF SPECIAL VALUE TO THE BEEKEEPER AS SOURCES OF POLLEN. 297 p., illus. Hamilton, Ill.
- (98) PENNELL, F. W.
1920. SCROPHULARIACEAE OF THE CENTRAL ROCKY MOUNTAIN STATES. U. S. Natl. Mus. Contrib. U. S. Natl. Herbarium 20: 313-381.
- (99) PIPER, C. V.
1906. FLORA OF THE STATE OF WASHINGTON. U. S. Natl. Mus. Contrib. U. S. Natl. Herbarium 11, 637 p., illus.
- (100) POTT, E.
1904-9. HANDBUCH DER TIERISCHEN ERNÄHRUNG UND DER LANDWIRTSCHAFTLICHEN FUTTERMITTEL. 3 v., gänzlich Neubearb. Aufl. der Landwirtschaftlichen Futtermittel. Berlin.
- (101) [PRIEN, O. L., and RAIFORD, L. C.]
1911. WOODY ASTER (XYLORRHIZA PARRYI GRAY). Wyo. Agr. Expt. Sta. Bul. 88, 20 p., illus.
- (102) ROBBINS, W. W.
1917. NATIVE VEGETATION AND CLIMATE OF COLORADO IN THEIR RELATION TO AGRICULTURE. Colo. Agr. Expt. Sta. Bul. 224, 56 p., illus.
- (103) ROCK, J. F.
1913. THE INDIGENOUS TREES OF THE HAWAIIAN ISLANDS. 518 p., illus. Honolulu.
- (103a) ROTHROCK, J. T., and others.
1878. BOTANY OF THE WHEELER SURVEY. (U. S. Geogr. Surveys West of the One Hundredth Meridian, Rpt. 6.) U. S. Army, Engin. Dept. 404 p., illus.
- (104) RUSSELL, F.
1908. THE PIMA INDIANS. U. S. Bur. Amer. Ethnol. Ann. Rpt. (1904-05) 26: 3-390, illus.
- (105) RYDBERG, P. A.
1898. A MONOGRAPH OF THE NORTH AMERICAN POTENTILLAE. 223 pp., illus. New York. (Thesis, Ph. D. Columbia University.) Columbia Univ. Dept. Bot. Mem. v. 2.
- (106) ———
1900. CATALOGUE OF THE FLORA OF MONTANA AND THE YELLOWSTONE NATIONAL PARK. Mem. N. Y. Bot. Gard., 492 p., illus.
- (107) ———
1922. FLORA OF THE ROCKY MOUNTAINS AND ADJACENT PLAINS, COLORADO, UTAH, WYOMING, IDAHO, MONTANA, SASKATCHEWAN, ALBERTA, AND NEIGHBORING PARTS OF NORTH DAKOTA AND BRITISH COLUMBIA. Ed. 2, 1143 p.
- (108) SAFFORD, W. E.
1915. EYSENHARDTIA POLYSTACHYA, THE SOURCE OF THE TRUE LIGNUM NEPHRITICUM MEXICANUM. Jour. Wash. Acad. Sci. 5: 503-517, illus.
- (109) ———
1921. PEYOTE, THE NARCOTIC MESCAL BUTTON OF THE INDIANS. Jour. Amer. Med. Assoc. 77: 1278-1279, illus.
- (110) SAMPSON, A. W.
1917. IMPORTANT RANGE PLANTS: THEIR LIFE HISTORY AND FORAGE VALUE. U. S. Dept. Agr. Bul. 545, 63 p., illus.
- (111) ———
1919. EFFECT OF GRAZING UPON ASPEN REPRODUCTION. U. S. Dept. Agr. Bul. 741, 29 p., illus.
- (112) ———
1919. PLANT SUCCESSION IN RELATION TO RANGE MANAGEMENT. U. S. Dept. Agr. Bul. 791, 76 p., illus.

- (113) SAMPSON, A. W. and DAYTON, W. A.
1913. RELATION OF GRAZING TO TIMBER REPRODUCTION, SHASTA NATIONAL FOREST. U. S. Dept. Agr., Rev. For. Serv. Invest. 2: 18-24, illus.
- (114) ——— and MALMSTEN, H. E.
1926. GRAZING PERIODS AND FORAGE PRODUCTION ON THE NATIONAL FORESTS. U. S. Dept. Agr. Bul. 1405, 55 p., illus.
- (115) ——— and WEYL, L. H.
1918. RANGE PRESERVATION AND ITS RETATION TO EROSION CONTROL ON WESTERN GRAZING LANDS. U. S. Dept. Agr. Bul. 675, 35 p., illus.
- (116) SARGENT, C. S.
1922. MANUAL OF THE TREES OF NORTH AMERICA (EXCLUSIVE OF MEXICO). Ed. 2, 910 p., illus. Boston and New York.
- (117) SARVIS, J. T.
1920. COMPOSITION AND DENSITY OF THE NATIVE VEGETATION IN THE VICINITY OF THE NORTHERN GREAT PLAINS FIELD STATION. Jour. Agr. Research 19: 63-72, illus.
- (118) SCHNEIDER, A.
1912. PHARMACAL PLANTS AND THEIR CULTURE. Calif. State Bd. Forestry Bul. 2, 175 p.
- (119) SHANTZ, H. L.
1911. NATURAL VEGETATION AS AN INDICATOR OF THE CAPABILITIES OF LAND FOR CROP PRODUCTION IN THE GREAT PLAINS AREA. U. S. Dept. Agr., Bur. Plant Indus. Bul. 201, 100 p., illus.
- (120) ——— and ZON, R.
1924. ATLAS OF AMERICAN AGRICULTURE. Pt. I, THE PHYSICAL BASIS OF AGRICULTURE. SEC. E., THE NATURAL VEGETATION OF THE UNITED STATES. GRASSLAND AND DESERT SHRUB. U. S. Dept. Agr. 27 p., illus.
- (121) SHINN, C. H.
1913. AN ECONOMIC STUDY OF ACACIAS. U. S. Dept. Agr., Forest Serv. Bul. 9, 38 p., illus.
- (122) SHREVE, E. B.
1923. SEASONAL CHANGES IN THE WATER RELATIONS OF DESERT PLANTS. Ecology 4: 266-292, illus.
- (123) ———
1924. FACTORS GOVERNING SEASONAL CHANGES IN TRANSPIRATION OF ENCELIA FARINOSA. Bot. Gaz. 77: 432-439.
- (124) SMITH, J. G.
1900. FODDER AND FORAGE PLANTS, EXCLUSIVE OF THE GRASSES. U. S. Dept. Agr., Div. Agrost. Bul. 2, rev. ed., 86 p., illus.
- (125) SPARHAWK, W. N.
1918. EFFECT OF GRAZING UPON WESTERN YELLOW PINE REPRODUCTION IN CENTRAL IDAHO. U. S. Dept. Agr. Bul. 738, 31 p., illus.
- (126) STANDLEY, P. C.
1922. TREES AND SHRUBS OF MEXICO (FAGACEAE-FABACEAE). U. S. Natl. Mus. Contrib. U. S. Natl. Herbarium 23: 171-515.
- (127) ———
1923. TREES AND SHRUBS OF MEXICO (OXALIDACEAE-TURNERACEAE). U. S. Natl. Mus. Contrib. U. S. Natl. Herbarium 23: 517-848.
- (128) ———
1924. TREES AND SHRUBS OF MEXICO (PASSIFLORACEAE-SCROPHULARIACEAE). U. S. Natl. Mus. Contrib. U. S. Natl. Herbarium 23: 849-1312.
- (129) STEVENSON, M. C.
1915. ETHNOBOTANY OF THE ZUÑI INDIANS. U. S. Bur. Amer. Ethnol. Ann. Rpt. (1908/09) 30: 35-102, illus.
- (130) SUDWORTH, G. B.
1908. FOREST TREES OF THE PACIFIC SLOPE. Washington, [D. C.] 441 p., illus.
- (131) ———
1927. CHECK LIST OF THE FOREST TREES OF THE UNITED STATES, THEIR NAMES AND RANGES. U. S. Dept. Agr. Misc. Circ. 92, 295 p.
- (132) THORNBUR, J. J.
1910. THE GRAZING RANGES OF ARIZONA. Ariz. Agr. Expt. Sta. Bul. 65, p. [245]-360, illus.

- (133) THORNER, J. J.
1916. IN "PROF. THORNER TELLS OF POISONOUS PLANT." Southwest. Stockman-Farmer 32: 156.
- (134) TIDESTROM, I.
1925. FLORA OF UTAH AND NEVADA. U. S. Natl. Mus. Contrib. U. S. Natl. Herbarium 25, 665 p., illus.
- (135) TRELEASE, W.
1924. THE AMERICAN OAKS. Mem. Natl. Acad. Sci. 20, 255 p., illus.
- (136) UNITED STATES DEPARTMENT OF AGRICULTURE, FOREST SERVICE.
1923. INSTRUCTIONS FOR GRAZING RECONNAISSANCE ON NATIONAL FORESTS. (Prepared chiefly by W. R. Chapline and C. L. Forsling.)
- (137) VANSSELL, G. H.
1926. BUCKEYE POISONING OF THE HONEY BEE. Calif. Agr. Expt. Sta. Circ. 301, 12 p., illus.
- (138) VASEY, G., and ROSE, J. N.
1890. LIST OF PLANTS COLLECTED BY DR. EDWARD PALMER IN LOWER CALIFORNIA IN 1889. U. S. Natl. Mus. Contrib. U. S. Natl. Herbarium 1: 9-28.
- (139) ——— and ROSE, J. N.
1890. LIST OF PLANTS COLLECTED BY DR. EDWARD PALMER IN 1890 IN LOWER CALIFORNIA AND WESTERN MEXICO. U. S. Natl. Mus. Contrib. U. S. Natl. Herbarium 1: 63-90, illus.
- (140) VIEHMEYER, A., and CAPEN, R.
1922. A NEW SOURCE OF SANTONIN. Science (n. s.) 56: 115.
- (141) WALTON, G. P.
1923. A CHEMICAL AND STRUCTURAL STUDY OF MESQUITE, CAROB, AND HONEY LOCUST BEANS. U. S. Dept. Agr. Bul. 1194, 20 p., illus.
- (142) WILSON, C. P.
1928. FACTORS AFFECTING THE GERMINATION AND GROWTH OF CHAMIZA (ATRIPLEX CANESCENS). N. Mex. Agr. Expt. Sta. Bul. 169, 29 p., illus.
- (143) [WILSON, N. E., DINSMORE, S. C., and KENNEDY, P. B.]
1906. NATIVE FORAGE PLANTS AND THEIR CHEMICAL COMPOSITION. Nev. Agr. Expt. Sta. Bul. 62, 41 p., illus.
- (144) WOOD, H. C., REMINGTON, J. P., and SADTLER, S. P., assisted by LYONS, A. B., and WOOD, H. C. JR.
1907. THE DISPENSATORY OF THE UNITED STATES OF AMERICA, BY DR. GEO. B. WOOD AND DR. FRANKLIN BACHE. Ed. 19, thoroughly rev. and largely rewritten...1,947 p. Philadelphia and London.
- (145) WOODWARD, T. E., TURNER, W. F., and GRIFFITHS, D.
1915. PRICKLY-PEARS AS A FEED FOR DAIRY COWS. Jour. Agr. Research 4: 405-450, illus.
- (146) WOOTON, E. O.
1913. TREES AND SHRUBS OF NEW MEXICO. N. Mex. Agr. Expt. Sta. Bul. 87, 159 p., illus.
- (147) ——— and STANDLEY, P. C.
1915. FLORA OF NEW MEXICO. U. S. Natl. Mus. Contrib. U. S. Natl. Herbarium 19, 794 pp.

OTHER PUBLICATIONS

- BEATTIE, R. K.
1913. PLANTS USED FOR FOOD BY SHEEP ON THE MICA MOUNTAIN SUMMER RANGE. Wash. Agr. Expt. Sta. Bul. 113, 21 p., illus.
- BLANKINSHIP, J. W.
1905. NATIVE ECONOMIC PLANTS OF MONTANA. Mont. Agr. Expt. Sta. Bul. 56, 36 p.
- BRAY, W. L.
1910. THE MISTLETOE PEST IN THE SOUTHWEST. U. S. Dept. Agr., Bur. Plant Indus. Bul. 166, 39 p., illus.
- BRITTON, N. L., and SHAFER, J. A.
1908. NORTH AMERICAN TREES... 894 p., illus. New York.
- BROWN, L. S.
1922. THE UTILITY OF YUCCA AND CHAMIZA AS RANGE SUPPLEMENTS. N. Mex. Agr. Expt. Sta. Bul. 133, 38 p., illus.
- CAMPBELL, R. S.
1929. SOAPWEED (YUCCA ELATA). N. Mex. Agr. Expt. Sta. Press Bul. 576, 2 p. [Mimeographed.]

CATLIN, C. N.

1925. COMPOSITION OF ARIZONA FORAGES, WITH COMPARATIVE DATA. Ariz. Agr. Expt. Sta. Bul. 113 p. [155]-173.

DURRELL, L. W., and GLOVER, G. H.

1927. POISONOUS PLANTS OF COLORADO. Colo. Agr. Expt. Sta. Bul. 316, 28 p., illus.

FLEMING, C. E., MILLER, M. R., and VAWTER, L. R.

1928. THE GREASEWOOD (*SARCOPATUS VERMICULATUS*) A RANGE PLANT POISONOUS TO SHEEP. Nev. Agr. Expt. Sta. Bul. 115, 22 p., illus.

FORSLING, C. L.,

1924. SAVING LIVE STOCK FROM STARVATION ON SOUTHWESTERN RANGES. U. S. Dept. Agr. Farmers' Bul. 1428, 22 p., illus.

— and STORM, E. V.

1929. THE UTILIZATION OF BROWSE FORAGE AS SUMMER RANGE FOR CATTLE IN SOUTHWESTERN UTAH. U. S. Dept. Agr. Circ. 62, 30 p., illus.

FOSTER, L., and HUMBLE, C. W.

1918. RANGE COW MAINTENANCE ON YUCCA AND SOTOL. N. Mex. Agr. Expt. Sta. Bul. 114, 27 p., illus.

FRYE, T. C., and RIGG, G. B.

- [1912.] NORTHWEST FLORA. 453 p. Seattle.

GRIFFITHS, D.

1901. RANGE IMPROVEMENT IN ARIZONA. U. S. Dept. Agr., Bur. Plant Indus. Bul. 4, 31 p., illus.

1910. A PROTECTED STOCK RANGE IN ARIZONA. U. S. Dept. Agr., Bur. Plant Indus. Bul. 177, 28 p., illus.

GRINNELL, G. B.

1923. THE CHEYENNE INDIANS, THEIR HISTORY AND WAYS OF LIFE. 2 v., illus. New Haven.

HANSON, H. C.

1929. IMPROVEMENT OF SAGEBRUSH RANGE IN COLORADO. Colo. Agr. Expt. Sta. Bul. 356, 12 p., illus.

HENRY, J. K.

- [1915.] FLORA OF SOUTHERN BRITISH COLUMBIA AND VANCOUVER ISLAND, WITH MANY REFERENCES TO ALASKA AND NORTHERN SPECIES. 363 p. Toronto.

HOUGH, R. B.

1907. HANDBOOK OF THE TREES OF THE NORTHERN STATES AND CANADA, EAST OF THE ROCKY MOUNTAINS. 470 p., illus. Lowville, N. Y.

HOWELL, T.

- 1897-1902. A FLORA OF NORTHWEST AMERICA, CONTAINING BRIEF DESCRIPTIONS OF ALL THE KNOWN INDIGENOUS AND NATURALIZED PLANTS GROWING WITHOUT CULTIVATION, NORTH OF CALIFORNIA, WEST OF UTAH, AND SOUTH OF BRITISH COLUMBIA. v. 1, 792 p. Portland, Oreg.

JARDINE, J. T., and ANDERSON, M.

1919. RANGE MANAGEMENT ON THE NATIONAL FORESTS. U. S. Dept. Agr. Bul. 790, 98 p., illus.

— and HURTT, L. C.

1917. INCREASED CATTLE PRODUCTION ON SOUTHWESTERN RANGES. U. S. Dept. Agr. Bul. 588, 32 p., illus.

KENNEDY, P. B.

1903. SUMMER RANGES OF EASTERN NEVADA SHEEP. Nev. Agr. Expt. Sta. Bul. 55, 53 p., illus.

— and DOTEN, S. B.

1901. A PRELIMINARY REPORT ON THE SUMMER RANGES OF WESTERN NEVADA SHEEP. Nev. Agr. Expt. Sta. Bul. 51, 55 p., illus.

KORSTIAN, C. F., and LONG, W. H.

1922. THE WESTERN YELLOW PINE MISTLETOE. EFFECT ON GROWTH AND SUGGESTIONS FOR CONTROL. U. S. Dept. Agr. Bul. 1112, 36 p., illus.

LEOPOLD, A.

1924. GRASS, BRUSH, TIMBER, AND FIRE IN SOUTHERN ARIZONA. Jour. Forestry 22: 1-10.

MCCREARY, O.

1927. WYOMING FORAGE PLANTS AND THEIR CHEMICAL COMPOSITION—STUDIES NO. 8. Wyo. Agr. Expt. Sta. Bul. 157, p. [91]-106.

MARSH, C. D., CLAWSON, A. B., and ROE, G. C.

1927. WILD TOBACCOS (*NICOTIANA TRIGONOPHYLLA* DUNAL AND *NICOTIANA ATTENUATA* TORREY) AS STOCK-POISONING PLANTS. U. S. Dept. Agr. Tech. Bul. 22, 23 p., illus.

MEARNS, E. A.

1907. MAMMALS OF THE MEXICAN BOUNDARY OF THE UNITED STATES . . . PART I FAMILIES BIDEPLHIDÆ TO MURIDÆ. U. S. Natl. Mus. Bul. 56, 530 p., illus.

NELSON, E. E.

1902. THE SHRUBS OF WYOMING. Wyo. Agr. Expt. Sta. Bul. 54, 47 p., illus.

PIPER, C. V., and BEATTIE, R. K.

1914. FLORA OF SOUTHEASTERN WASHINGTON AND ADJACENT IDAHO. 296 p., illus. Lancaster, Pa.

—— and BEATTIE, R. K.

1915. FLORA OF THE NORTHWEST COAST . . . 418 p. Lancaster, Pa.

——, VINALL, H. N., OAKLEY, R. A., CARRIER, L., BAKER, O. E., COTTON, J. S., and others.

1924. OUR FORAGE RESOURCES. U. S. Dept. Agr. Yearbook 1923: 311-413, illus.

RYDBERG, P. A.

1905. FLORA OF COLORADO. Colo. Agr. Expt. Sta. Bul. 100, 448 p.

SAMPSON, A. W.

1924. NATIVE AMERICAN FORAGE PLANTS. 435 p., illus. New York.

SMALL, J. K.

1913. FLORA OF THE SOUTHEASTERN UNITED STATES . . . Ed. 2, 1,394 p. New York.

STANDLEY, P. C.

1921. FLORA OF GLACIER NATIONAL PARK, MONTANA. U. S. Natl. Mus. Contrib. U. S. Natl. Herbarium 22: 235-438, illus.

WATSON, S.

1871. BOTANY. U. S. Geol. Exploration Fortieth Parallel. 525 p., illus. [Rpt. v. 5]

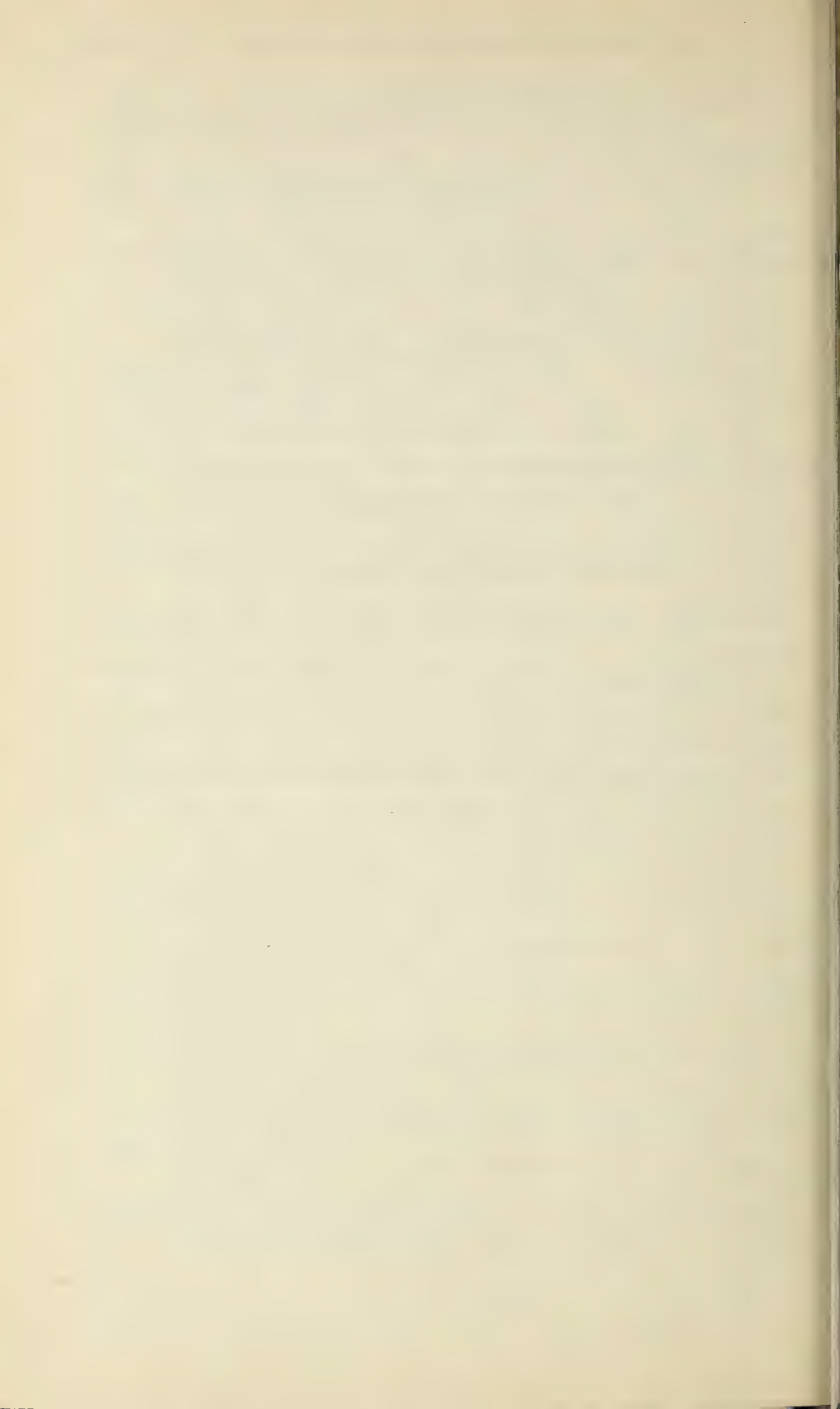
WILLIAMS, R. H.

1918. FEEDING YUCCA TO STARVING CATTLE. Ariz. Agr. Expt. Sta. Circ. 21, 10 p., illus.

WOOTON, E. O.

1908. THE RANGE PROBLEM IN NEW MEXICO. N. Mex. Agr. Expt. Sta. Bul. 66, 46 p., illus.

1918. CERTAIN DESERT PLANTS AS EMERGENCY STOCK FEED. U. S. Dept. Agr. Bul. 728, 31 p., illus.



INDEX

This index has been arranged to serve also as a check list of the genera, species, subspecies, and varieties of plants discussed in the body of the publication. Accepted names of native browse species and genera, both English and Latin, appear in heavy type. Where the Latin and English generic names are identical (e. g., *Acacia*, *Rhododendron*, and *Viburnum*) the name is not repeated.

Where two or more page references are given, any considerable discussion of the subject is indicated in heavy type.

Exotic genera and species are indicated by the mark (†).

- † *Abies pectinata* (silver fir), 11.
 Abrams, Leroy, 23, 180.
 Abrojo, 114, 116.
 Abutilon, 115.
Acacia, 8, 71-73.
 catclaw, 71.
 constricta (mescat a.), 71-72.
 dwarf, 71.
 fernleaf (*A. filicioides*), 71-72.
 filicioides (fernleaf a.), 71-72.
 Gregg ('s), 71.
 greggii (catclaw), 71, 72, 179.
 Lemmon (*A. lemmoni*), 71-72.
 lemmoni (Lemmon a.), 71-72.
 mescat (*A. constricta*), 71-72.
 netvein (*A. reticulata*), 72-73.
 reticulata (netvein a.), 72-73.
Acalypha (copperleaf), 93.
 Acanthaceae, 144-145.
 Acanthus family, 144-145.
Acer (maple), 9, 98-102, 179.
 brachypterum (Southwestern m.), 99, 100.
 californicum (California boxelder), 102.
 circinatum (vine m.), 99, 100.
 douglasii (Douglas m.), 98, 99, 100.
 glabrum (Rocky Mountain m.), 98-100.
 glabrum douglasii, 98, 100.
 grandidentatum (bigtooth m.), 100, 101.
 interius (inland boxelder), 101, 102.
 macrophyllum (bigleaf m.), 98, 100-102.
 negundo (boxelder), 102.
 negundo californicum, 102.
 negundo interius, 102.
 neomexicanum, 98.
 saccharum (sugar m.), 98.
 Aceraceae, 98-102.
 Achania, 114.
 Aciphyllaea, 165, 166.
 acerosa, 166.
Adelia (Forestiera), 93, 137.
 neomexicana, 137.
 New Mexican (*F. neomexicana*), 137.
Adenostoma, 7.
 fasciculatum (chamiso), 53-55, 179.
 sparsifolium (redshanks), 54, 55.
Adolphia californica; *A. infesta*, 111.
 Aesculaceae, 102.
Aesculus (horsechestnut), 102.
 californica (California buckeye), 102, 180.
 Agarita, 37.
 Agrillo, 37.
 Agrito(s), 37.
 Alamo National Forest. See Lincoln National Forest.
 † Albizzia, 73.
 Alder (*Alnus*), 9, 18, 46, 100, 121, 126, 147.
 mountain (*A. tenuifolia*), 18.
 Oregon, 18.
 red (*A. rubra*), 18.
 Sitka (*A. sinuata*), 18.
 thinleaf, 18.
 Aldous, Alfred E., 4, 45, 180.
 † Alfalfa (*Medicago sativa*), 22, 28, 29, 172.
 † *Alfilera* (*Erodium cicutarium*), 73.
 Algaroba, 77.
 Algerita, 37.
 Algodoncilla, 114.
 Alkali, 8, 33, 34, 176, 177.
 black, 28, 34.
 disease, 9, 156.
 white, 28.
 Alkaloids, 11, 37, 86, 89, 104, 107, 131, 145, 147, 150, 158.
 Allenrolfea, 34.
 occidentalis (burroweed), 36.
 All-thorn (*Koerberlinia spinosa*), 116.
 family, 115-116.
 Alluvial deposits, 141.
 strands, 166.
 † Almond (*Amygdalus*), 66, 69.
 Anderson, 70.
 California desert, 70.
 desert, 70.
 family, 7, 66-70.
 Nevada wild, 70.
 Torrey wild (*Emplectocladus fasciculatus*), 70.
 wild, 69.
Alnus (alder), 18, 180.
 alnobetula, 18.
 oregona, 18.
 rubra (red a.), 18.
 sinuata (Sitka a.), 18.
 tenuifolia (mountain a.), 18.
 Aloes, bitter, 49.
 Alpine type. See Type.
 Ambrosia (ragweed), 153.
 Ambrosiaceae, 153-155.
 Ambrosieae, 153-155.
Amelanchier (serviceberry), 7, 60-63, 150.
 alnifolia (common s.), 60-62.
 florida (Pacific s.), 62.
 oreophila (mountain s.), 62.
 polycarpa (cluster s.), 62-63.
 rubescens (redbud s.), 63.
 utahensis (Utah s.), 63.
 American Joint Committee on Horticultural Nomenclature, 10, 12, 45, 65, 71, 98, 104, 122, 132, 170, 180.
Ammobroma sonora (sandroot), 154.
 Amole, 14.
Amorpha (indigobush), 2, 82-83, 86, 179.
 californica (California i.), 83.
 canescens (leadplant), 2, 83.
 downy, 83.
 fragrans, 83.
 fruticosa (indigobush), 83.
 microphylla, 83.
 nana (dwarf i.), 83.
 occidentalis (desert i.), 83.
 Amygdalaceae, 7, 66-70.
 Amygdalin, 45.

- † *Amygdalus* (almond), 66, 69.
andersonii, 70.
fasciculatus, 70.
fremontii, 70.
Anacardiaceae, 9, 95-97.
† *Anacardium occidentale* (cashew), 95.
Anderson, Mark, 4, 188.
Andrachne, 93.
Andromeda polifolia (bog-rosemary), 122-123.
Andromedotoxin, 122, 131, 133.
Anhalonium, 118.
Anisacanth (*Anisacanthus*), 144-145.
dwarf (*A. insignis*), 145.
Thurber (*A. thurberi*), 144-145.
Wright (*A. wrightii*), 145.
Anisacanthus (*anisacanth*), 144-145.
insignis (dwarf a.), 145.
pumilus, 145.
Thurberi (*Thurber a.*), 144-145, 179.
Wrightii (*Wright a.*), 145.
Antelope. See Wild life.
Antelope-brush, 53, 179.
Anthemideae, 166-176.
Anthonomous grandis thurberiae, host of, 115.
Apache plume (*Fallugia paradoxa*), 7, 50-51.
Aplopappus (goldenweed), 8, 156-157, 160.
arborescens (goldenfleece), 156.
bloomeri (Bloomer rabbit brush), 156.
discoideus, 157.
fruticosus, 157.
heterophyllus (Jimmyweed), 156-157, 180.
laricifolius, 156.
linearis, 157.
macronema (whitestem g.), 157.
palmeri, 156.
suffrutescens (singlehead g.), 157.
venetus, 156.
Apocynaceae, 139.
Apple (*Malus*), 65-66.
family, 7, 60-65.
Oregon, 65.
Oregon crab (*M. fusca*), 65-66.
Pacific, 65.
wild, 65.
† Apricot (*Prunus armeniaca*), 66.
Arbol de hierro, 86.
Arbutus (madrone), 9, 122, 123.
arizonica (Arizona m.), 123.
menziesii (Pacific m.), 123, 179.
texana (Texas m.), 123.
xalapensis (Mexican m.), 123.
Archer, W. A., 67, 156, 183.
Arctostaphylos (manzanita), 9, 122, 123-126, 179.
nevadensis (pinemat), 124-126.
patula (greenleaf m.), 124, 125.
platyphylla, 124.
pungens (pointleaf m.), 124.
pungens *platyphylla*, 124.
uva-ursi (bearberry), 123, 124, 125.
Arctotis, 124.
Ariocarpus (living-rock), 118.
Arrowbush, 164.
Arrowweed (*Pluchea sericea*), 164.
Arrowwood, 154, 164.
Artemisia (sagebrush, etc.), 3, 8, 141, 166-176.
absinthium (common wormwood), 172.
arbuscula (low s.), 173.
aromatica, 173.
bakeri, 176.
bigelovii (Bigelow s.), 173.
californica (California s.), 173.
cana (silver s.), 169-170.
carruthii (Carruth s.), 173.
discolor incompta, 175.
dracunculoides (false tarragon), 173-174.
filifolia (sand s.), 175.
floccosa (woolly s.), 175.
franserioides (ragweed s.), 175.
frigida (estafiata, or pasture s.), 170-172.
gnaphalodes (cudweed s.), 174, 175.
incompta (sweet s.), 175, 180.
kansana, 173.
longifolia, 176.
Artemisia—Continued.
ludoviciana (Louisiana wormwood), 175.
mexicana (Mexican wormwood), 175-176.
natronensis (alkali s.), 176.
neomexicana (New Mexican wormwood), 175-176.
nova (small s.), 169.
rigida (stiff s.), 176.
silvicola, 175.
spinescens (bud s.), 172-173, 180.
tridentata (big s.), 23, 34, 161, 167-169, 173, 180.
tridentata nova, 169.
tripartita (threetip s.), 176.
vulgaris discolor, 175.
wrightii (Wright s.), 176.
Ash (*Fraxinus*), 137-138.
Arizona, 137.
desert, 137.
dwarf, 137.
flowering, 137.
fragrant (*F. cuspidata*), 137.
leatherleaf (*F. coriacea*), 137.
mountain, 137.
Oregon (*F. oregona*), 138.
singleleaf (*F. anomala*), 137.
Toumey (*F. attenuata*), 137.
velvet (*F. velutina*), 137.
wafer, 91.
white, 3.
Aspen (*Populus*), 9, 16, 17, 46, 60, 62, 68, 99, 119, 121, 148, 150, 169, 173.
(*P. tremuloides*; *P. tremuloides aurea*), 17.
quaking, 17.
Associations. See Types.
Aster, 8, 157-158.
alkali (*A. glabriusculus*), 157-158.
family, 7, 153-179.
glabriusculus (alkali a.), 157-158.
Parry (*A. parryi*), 157.
parryi (Parry a.), 157, 180.
spiny (sec. *Linosyris*), 157.
tribe, 156-164.
woody (sec. *Xylorrhiza*), 8, 157.
Asteraceae, 7, 8, 153-179.
Asteraceae, 156-164.
Astrophyllum dumosum, 91.
Atole, 76.
Atragene columbiana; *A. occidentalis*, 36.
Atriplex (saltbush), 3, 8, 27-31, 180.
bushy, 28.
canescens (fourwings s.), 28-30.
confertifolia (shadscale), 28, 30-31.
hastata, 27.
hortensis (garden orach), 27.
lentiformis (big s.), 31.
nuttallii (Nuttall s.), 31.
semibaccata (Australian s.), 30.
Audibertia incana; *A. nivea*; *A. polystachya*; *A. stachyoides*, 141.
Audibertiella argentea; *A. incana*, 141.
Avocado (*Persea americana*), 38.
Ayenia, 115.
Azafan del campo, 138.
Azalea, 9, 126, 132.
albiflora, 126.
California, 126.
false- (Azaleastrum albiflorum), 126, 132.
occidentalis (western a.), 126, 127, 179, 180.
western (*A. occidentalis*), 126, 127.
Azaleastrum, 126, 132.
albiflorum (false-azalea), 126, 179, 180.
Baccharin, 158.
Baccharis, 8, 158-160, 180.
amigdalina, 158.
broom (*B. sarothroides*), 160.
coriifolia (mio mio), 158.
Emory (*B. emoryi*), 158.
emoryi (*B. emoryi*), 158.
glutinosa (seepwillow), 158, 179.
pilularis (kidneywort), 160, 179.
pterionoides, 158.
ramulosa (yerba-de-pasmo), 158, 159, 180.
sarothroides (broom b.), 160, 180.
winged, 158.

- Bache, Franklin, 153, 158, 169, 187.
 Bagote, 79.
 Bailey, L. H., 70, 180.
 Bailey, Vernon, 118, 154, 180.
 Baker, O. E., 189.
 Ball, C. R., 4.
 Balm, mountain, 109, 139.
 Bannal, 85.
 Barber, H. S., 162.
Barberry (*Berberis*), 36.
 family, 36-37.
 Fendler (*B. fendleri*), 179.
 hollyleaf, 36.
Barchatas, 113.
Bark, cramp, 153.
 medicinal, 73, 91, 113, 121, 179.
 panbotano, 73.
 poisonous, 136.
 Barlow, Waldo D., 4.
 Barnes, Will C., 172.
Batodendron (tree-huckleberry), 133.
Bayberry (*Myrica* spp.), 179.
 Bay (tree), California, 39.
 Bean family, 7, 79, 82-89.
Bearberry (*Arctostaphylos uva-ursi*), 3, 123, 124, 125.
 (*Garrya wrightii*), 122.
 (*Lonicera involucrata*), 146.
 alpine. See Ptarmiganberry.
 Sierra, 124.
Bear brush. See Brush, bear.
Bear-clover, 55.
Beardtongue, 143.
Beardgrass, 15.
Bearmat (*Chamaebatia foliolosa*), 7, 55.
 (*Chamaebatiaria millefolium*), 55.
Bears. See Wild Life.
 Beath, O. A., 157, 180.
 Beattie, R. Kent, 187, 189.
 Beaverhead National Forest, 147, 157.
Bedstraw (*Galium* spp.), 145-146.
 Bee plants, 71, 76, 80, 87, 102, 107, 123, 132, 140, 141, 179.
Beloperone californica, 145, 179.
Berberidaceae, 36-37.
Berberis (*barberry*), 36.
 fendleri (*Fendler b.*), 179.
Bernardia myricaefolia, 93.
Berry, coffee, 94, 113, 122.
 pigeon, 60, 113.
 rabbit, 119.
 two-eyed, 146.
Berthelotia sericea, 164.
Besom, 85.
Betula (*birch*), 3, 18-19, 180.
 fontinalis (red b.), 18.
 glandulosa (resin b.), 18-19.
 kenaica (*Kenai b.*), 19.
 lenta (sweet b.), 105.
 rotundifolia (ground b.), 19.
Betulaceae, 9, 18-19.
 Bidwell, G. L., 30, 33, 36, 180.
Bigelovia, 156, 160.
 arborescens, 156.
 coronopifolia, 157.
 douglasii, 161.
 douglasii pumila, 163.
 douglasii serculata, 163.
 douglasii tortifolia, 163.
 lanceolata, 160.
 veneta, 156.
 wrightii, 156.
Bignonia stans, 144.
Bignoniaceae, 144.
Bilberry, 133.
 big, 135.
 dwarf, 134.
 high (bush), 133.
 large, 133.
 oval-leaf, 135.
 red, 135.
 tall, 135.
 tall red, 135.
 thinleaf, 133.
 Billings, Nelson Jay, 4.
Birch (*Betula* spp.), 2, 9, 18-19, 99, 107, 121.
 family, 9, 18-19.
 ground (*B. rotundifolia*), 19.
 Kenai (*B. kenaica*), 19.
 mountain, 18.
 mountain bog, 18.
 red (*B. fontinalis*), 18.
 resin (*B. glandulosa*), 18-19.
 silver, 118.
 sweet (*B. lenta*), 105.
 water, 18.
Birds. See Wild life; fruit.
 Bisnaga, 118.
Bitterbrush (*Furshia tridentata*), 6, 7, 52-53, 176.
 (*Cowania stansburiana*), 49.
Bittersweet, American (*Celastrus scandens*), 97.
 Black, O. F., 12, 180.
Blackhead (*Pithecollobium unguis-cati*), 71.
Blackberry (*Rubus*), 7, 57-58.
Blackbrush (*Coleogyne ramosissima*), 3, 7, 55, 144.
 (*Cercocarpus* spp.), 43.
 (*Flourensia cernua*), 165.
Blackbush, 43, 48, 55.
Blackcap. See *Rubus* spp.
Blackfoot (*Melampodium*), 165.
 plains (*M. leucanthum*), 165.
Black laurel. See Laurel, black.
 Blake, S. F., 4, 153.
 Blankinship, J. W., 187.
 Blister-rust, white pine, 40, 41, 42, 43.
 Elite, sea, 36. See Seepweed (*Dondia*).
 Blossom, blue, 105.
Blueberry (*Vaccinium*), 133-136.
 big, 135.
 box (*V. ovatum*), 135.
 Canada (*V. canadense*), 134.
 family, 133-136.
 lowbush (*V. angustifolium*), 134.
 oval-leaf, 135.
 red, 135.
 red alpine, 135.
 swamp, 134.
 tall, 135.
 tall red, 135.
 velvetleaf, 134.
 western, 134.
 western bog (*V. occidentale*), 134-135.
 Blue blossom, 105.
Bluebrush (*Ceanothus integrifolius*), 9, 104, 105-107, 109.
 Lemmon (*C. lemmoni*), 107.
 trailing (*C. diversifolius*), 107.
Bluebush, 105.
Bluewood (*Condalia obovata*), 111-113.
 Blyth, Alexander Wynter, 86, 180.
 Boebera, 165.
 papposa, 166.
Bog-rosemary (*Andromeda polifolia*), 122-123.
 Bogs, 122, 128, 130, 134.
 Boll-weevil, wild cotton, host of, 115.
Bossekia nutkana; *B. parviflora*. See *Rubus parviflorus*.
 Bottom lands, 39, 49, 50, 63, 65, 68, 69, 77, 100, 101, 102, 119, 120, 121, 133, 138.
 See also River bottoms.
Bouteloua eriopoda (black grama), 14.
 gracilis (blue g.), 32, 169.
 Boutry, 149.
 Bouvardia, 145.
 † Box, common (*Buxus sempervirens*), 94.
 false, 98.
 family, 9, 94-95.
Boxelder (sec. Negundo, genus *Acer*), 98, 102.
 California (*A. californicum*), 102.
 inland (*A. interius*), 102.
Boxleaf, myrtle (*Pachistima myrsinites*), 98.
 Boxthorn, 142.
 Boxwood, 98.
 Bracken, 69, 128.
 Brasil, 112.
 Bray, William L., 97, 181, 187.
 Brenizer, Mrs. N. B., 4.

- Brewer, W. H., 65, 91, 181.
 Brickellbush (*Coleosanthus*), 155.
 bigleaf (*C. floribundus*), 155.
 California (*C. californicus*), 155.
Brickellia brachiata; *B. californica*; *B. floribunda*; *B. glabrata*, 155.
 Brigham-tea, 12.
 Brittlebrush, 164.
 Brittlebush, white (*Encelia farinosa*), 164-165.
 Britton, Nathaniel Lord, 83, 179, 181, 187.
 Bromegrass, 148.
 †Broom (*Cytisus* spp.), 7, 85-86.
 chaparral, 160.
 green, 85.
 Irish, 85.
 †Scotch (*C. scoparius*), 85-86.
 thorn, 89.
 turpentine, 91.
 Broomweed, 163.
Broussonetia secundiflora. See *Sophora secundiflora*.
 Brown, Addison, 83, 179, 181.
 Brown, Lee P., 4.
 Brown, Levi S., 187.
 Brownweed, 163.
 Browse, definition of, 1.
 distribution of, 1-2.
 fall, 9, 17, 21, 22, 31, 32, 33, 40, 43, 45, 48, 53, 57, 58, 59, 60, 61, 62, 63, 65, 66, 67, 68, 69, 70, 73, 76, 79, 86, 113, 119, 121, 134, 135, 137, 138, 139, 140, 147, 148, 149, 152, 156, 158, 160, 161, 163, 165, 167, 169, 170, 173, 175, 176, 179. See also Range, fall.
 miscellaneous uses and properties of, 179-180.
 number of families, genera, and species, 1.
 palatability of, 4-10.
 percentage of species having economic significance, 3.
 spring, 21, 22, 24, 31, 33, 41, 45, 53, 61, 63, 66, 68, 70, 71, 73, 79, 80, 82, 86, 111, 122, 134, 135, 137, 138, 139, 143, 145, 156, 163, 167, 169, 172, 173, 176, 177, 179. See also Range, spring.
 summer, 17, 21, 24, 41, 43, 60, 61, 62, 63, 67, 68, 73, 79, 80, 82, 86, 121, 131, 134, 149, 152, 155, 157, 161, 167, 169, 176. See also Range, summer.
 tonic properties of, 33, 169.
 types, 1, 2, 3, 4. See also Types, brush; Chaparral.
 winter, 8, 12, 13, 15, 19, 22, 23, 24, 25, 28, 30, 31, 32, 33, 34, 36, 37, 39, 43, 45, 50, 51, 53, 55, 60, 69, 73, 76, 79, 86, 89, 107, 111, 113, 119, 121, 122, 124, 131, 135, 137, 138, 141, 142, 155, 158, 160, 161, 162, 163, 167, 168, 169, 170, 172, 173, 175, 176, 177. See also Range, winter.
 yearlong, 73, 111.
 Brush, antelope-. See Antelope-brush.
 bear, 121.
 bud, 172.
 deer, 43, 53, 105, 109, 150.
 hill, 173.
 quinine, 111.
 rabbit, 156.
 rosin, 160.
 Bubby-bush, 37.
 Buckbrush, 43, 53, 55, 66, 109, 142, 144, 149, 150.
 big, 147.
 Buckeye (*Aesculus*), 26, 102.
 California (*A. californica*), 102.
 Mexican. See Mexican-buckeye.
 New Mexican, 104.
 Spanish, 104.
 Buckthorn (*Rhamnus* spp.), 113; (*Lycium* spp.), 142.
 alder (*R. alnifolia*), 113.
 California (*R. californica*), 113.
 Buckthorn—Continued.
 cascara, 113.
 †common (*R. cathartica*), 113.
 family, 7, 8, 104-114.
 Texas, 114.
 Buckwheat family, 9, 27.
 Buckwheatbrush (*Eriogonum*), 27.
 slender (*E. microthecum*), 27.
 Wright (*E. wrightii*), 27.
 Bud brush, 172.
 Buddleia (butterflybush), 138.
 marrubiifolia (woolly b.), 138.
 scordoides (escobilla), 138.
 utahensis (Utah b.), 138.
 Budsage, 170, 172.
 Bufoleberry (*Lepargyrea*), 68, 119, 120.
 Canadian, 119.
 roundleaf (*L. rotundifolia*), 119, 120.
 russet (*L. canadensis*), 119, 120.
 silver (*L. argentea*), 119, 120.
 thornless, 119.
 Buffalo grass, 169.
 Bullberry, 119, 142.
 Bumelia, 180.
 Bunchberry (sec. *Chamaepericlymenum*, genus *Cornus*), 120, 121.
 Bundletwig, 177.
 Bureau of Chemistry and Soils, analyses made by, 22, 73, 94, 172.
 Bureau of Plant Industry, authority for Latin nomenclature, 10.
 Burningbush. See *Euonymus*.
 Burns, 15, 16, 41, 53, 54, 55, 109, 119, 121, 123, 124, 133, 146, 156.
 Burrobrush (*Hymenoclea monogyra*), 8, 154-155.
 Burrograss (*Scleropogon brevifolius*), 165.
 Burroweed (*Allenrolfea occidentalis*), 34, 36.
 (*Aplopappus fruticosus*), 157.
 (*Baccharis ramulosa*), 158.
 (*Franseria dumosa*), 154.
 Bur-sage (*Franseria*), 8, 153-154.
 triangle (*F. deltoidea*), 154.
 white (*F. dumosa*), 154.
 Bur, sand, 82, 154.
 Bush-honeysuckle, dwarf (*Diervilla lonicera*), 180.
 Bush, blue, 105.
 cinnamon, 39.
 coffee, 94.
 coyote, 160.
 creosote (*Covillea tridentata*), 2, 3, 71, 89-91, 94, 96, 137, 140, 141, 144, 154, 156, 165.
 snowdrop, 136.
 tallow, 43.
 thorn, 179.
 wait-a-minute, 79.
 Bushmint (*Hyptis*), 9, 140, 141.
 Emory (*H. emoryi*), 141.
 Bushnut, 94.
 Butneria, 37.
 Buttercup family, 6, 36.
 Butterflybush (*Buddleia*), 138.
 Utah (*B. utahensis*), 138.
 woolly (*B. marrubiifolia*), 138.
 Buttonbush (*Cephalanthus occidentalis*), 145.
 Buxaceae, 9, 94-95.
 †*Buxus sempervirens* (common box), 94.
 Cacao family, 115.
 Cachanilla, 164.
 Cache National Forest, 147.
 Cachimilla, 164.
 Cactaceae, 9, 116-118.
 Cactus, 5, 9, 116-118.
 Arizona water (*Echinocactus wislizeni*), 118.
 beehive (*Echinocactus* spp.), 180.
 cochineal, 118.
 family, 116-118.
 giant (*Carnegiea gigantea*), 118.
 singeing, 116.
 "spineless," 116.
 water (*Echinocactus* spp.), 180.
 Caesalpinaceae, 7, 8, 79-80.
 Cahill, James A., 4.

Cajeput-tree, 39.
 Cajotillo, 113.
 California-laurel (*Umbellularia californica*), 39.
 (*Arctostaphylos menziesii*), 123.
 California National Forest, 54.
 Calliandra (silkworm), 8, 73.
 erriophylla (false-mesquite), 73, 74.
 hairy-leaf, 73.
 houstoni, 73.
 †Calluna (heather), 126, 132.
 vulgaris (heather), 132.
 Caltrop family, 89-91.
 Calves, browse injurious to, 11, 27, 128, 130, 173.
 Calycanth, California, 37.
 Calycanthaceae, 37-38.
 Calycanthin, 37.
 Calycanthus (sweetshrub), 37-38.
 family, 37-38.
 fertilis, 37.
 floridus, 37.
 occidentalis (California s.), 37-38, 179, 180.
 Camote, 154.
 Campbell, Robert S., 4, 187.
 †Camphor-(tree) (*Cinnamomum camphora*), 38.
 Canatillo, 12.
 Candlewood, 115.
 Cane-cactus (*Opuntia arborescens*), 116, 117.
 Canotia, 5, 116.
 holacantha (canotia), 116.
 Canyons, 12, 19, 22, 24, 40, 48, 50, 55, 57, 60, 62, 65, 68, 69, 70, 76, 77, 79, 83, 85, 86, 87, 91, 98, 100, 102, 104, 122, 126, 137, 140, 144, 145, 158.
 Capen, Ruth, 176, 187.
 Caprifoliaceae, 7, 9, 146-153.
 Capulin, 112.
 Carbonate, calcium, 30.
 Caribou. *See* Wild life.
 Carlowrightia arizonica, 145.
 heath (*C. linearifolia*), 145.
 linearifolia (heath c.), 145.
 Carnegiea gigantea (giant cactus), 118.
 †Carob (*Ceratonia siliqua*), 77.
 Carphochaete, 8, 155.
 bigelovii, 155.
 Carrier, Lyman, 189.
 Cascade Mountains, 19, 40, 49, 123, 126, 128, 133, 134, 135.
 Cascara (*Rhamnus purshiana*), 113.
 Cascara sagrada, 113.
 †Cashew (*Anacardium occidentale*), 95.
 family, 9, 95-97.
 Cassia (*senna*, etc.), 179.
 family, 7, 8, 79-80.
 Cassidy, H. O., 4.
 Cassiope, 126-128, 179.
 Mertens (*C. mertensiana*), 127-128.
 mertensiana (Mertens c.), 126-128.
 tetragona, 126-128.
 Castanopsis, 19.
 chrysophylla (golden chinquapin), 179.
 sempervirens (Sierra chinquapin), 19.
 Catclaw (*Acacia greggii*), 8, 37, 71, 73, 82.
 See also Mimosa.
 false, 73.
 Catlin, C. N. 188.
 Cat's claw. *See* Catclaw.
 Ceanoth, 105.
 desert, 111.
 Ceanothus (bluebrush; soapbloom; hornbrush), 2, 3, 8, 9, 43, 68, 104-111, 112, 124, 179.
 cordulatus (whitethorn), 108-109.
 cuneatus (wedgeteaf h.), 111.
 desert, 111.
 divaricatus (whitebark s.), 109.
 diversifolius (trailing b.), 107.
 dwarf, 107.
 fendleri (Fendler s.), 109, 112, 124.
 greggii (Gregg h.), 111, 112, 124.
 integerrimus (bluebrush), 9, 105-107.
 lemmoni (Lemmon h.), 107.
 low, 107.
 martini (Martin s.), 109.

Ceanothus—Continued.
 nevadensis, 105.
 ovatus (inland Jersey-tea), 109.
 prostratus (squaw-carpet), 111.
 sanguineus (red s.), 110.
 velutinus (snowbrush), 105, 109, 110.
 Cedar, eastern red (*Juniperus virginiana*), 11.
 Rocky Mountain red (*J. scopulorum*), 11.
 Celastraceae, 97-98, 116.
 Celastrus (bittersweet), 97, 179.
 scandens (American b.), 97.
 Celtis (hackberry), 25, 179.
 douglasii (Douglas h.), 25.
 pallida (spiny h.), 25.
 reticulata (paloblanco), 25.
 Cenizo, 39.
 Cephalanthin, 145.
 Cephalanthus occidentalis (buttonbush), 145, 179.
 Cerastes, 105, 111.
 Cerasus, 66, 67, 68, 69. *See* Prunus.
 demissa, 68.
 demissa melanocarpa, 67.
 mollis, 69.
 prunifolia, 69.
 †Ceratonia siliqua (carob), 77.
 Cercidium (paloverde), 8, 79, 80.
 floridum (border p.), 80.
 microphyllum (littleleaf p.), 80.
 texanum (Texas p.), 80.
 torreyanum, 80.
 Cercis occidentalis (California redbud), 80.
 Cercocarpus (mountain-mahogany), 7, 43-46, 150, 179.
 argenteus (silver m.-m.), 45.
 arizonicus (Arizona m.-m.), 46.
 betulaefolius. *See* *C. betuloides*.
 betuloides (birchleaf m.-m.), 45.
 breviflorus (Wright m.-m.), 46.
 eximius, 46.
 intricatus, 46.
 ledifolius (curlleaf m.-m.), 43, 45, 46.
 montanus (true m.-m.), 43-45, 46.
 parviflorus, 43.
 Cereus, 3, 118.
 giganteus, 118.
 grandiflorus, 118.
 nightblooming (*Hylocereus* spp.), 118.
 Challis National Forest, 172.
 Chamaebatia, 7, 55.
 foliolosa (bearmat), 55.
 Chamaebatiaria millefolium (tansybush), 55.
 Chamaecyparis nootkatensis (Alaska cypress), 11.
 Chamaepericlymenum, 119, 121.
 Chamisa, 142, 153.
 Chamisal, 53.
 Chamise, 53, 111.
 Chamiso (*Adenostoma fasciculatum*), 7, 53-55.
 (*Lycium* spp.), 142.
 Chamiza, 28.
 Chaparral (or chaparral type), 1, 2, 22, 23, 37, 46, 48, 53, 54, 55, 68, 69, 80, 100, 107, 109, 110, 112, 114, 123, 147, 156. *See also* Types.
 (*Castanopsis sempervirens*), 19.
 (*Ceanothus cuneatus*), 111.
 (*Garrya wrightii*), 122.
 broom, 160.
 millefoil, 55.
 millefolium, 55.
 Chapline, William R., 4, 5, 10, 21, 22, 24, 39, 66, 87, 122, 124, 150, 181, 187.
 Check List of the Forest Trees of the United States. *See* Sudworth, George B.
 Chenopodiaceae, 7, 8, 27-36.
 Cherry (*Prunus* spp.), 7, 66, 67, 68, 69.
 bird, 69.
 bitter (*P. emarginata*), 69.
 bluntleaf, 69.
 narrowleaf, 69.
 pigeon, 69.
 pin (*P. pennsylvanica*), 69.
 plumleaf (*P. prunifolia*), 69.
 quinine, 69.
 †sour (*P. cerasus*), 66.
 Southwestern black (*P. virens*), 68-69.

- Cherry—Continued.
sweet. *See* Mazzard.
wild, 67.
wild red, 69.
- Cherry-laurel (sec. *Laurocerasus*, genus *Prunus*), 66, 67.
- Chesnut, Victor K., 37, 67, 89, 102, 123, 131, 133, 179, 181.
- Chico, 34.
- †Chicory subfamily, 8, 177-179.
- Chilicote, 86.
- Chilopsis; *C. linearis* (desertwillow), 94, 144.
saligna, 144.
- Chimaphila umbellata (common pipsissewa), 179.
- †Chinaberry (*Melia azedarach*), 104.
- China-tree, wild, 104.
- Chinquapin, bush, 19.
California, 19.
goldleaf, 19.
Sierra (*Castanopsis sempervirens*), 19.
- Chiricahua National Forest. *See* Coronado National Forest.
- Chittam, 113.
- Choisya dumosa (starleaf), 91, 92.
- Chokecherry (sec. *Padus*, genus *Prunus*), 7, 60, 62, 63, 66, 67-68, 69, 148, 150.
black (*P. melanocarpa*), 67-68.
black western, 67.
common (*P. virginiana*), 68.
eastern, 68.
evergreen, 68.
Virginia, 68.
western (*P. demissa*), 68.
- Cholla (sec. *Cylindropuntia*, genus *Opuntia*), 116.
- Christ, tree of, 116.
- Chrysactinia mexicana (damiañita), 166.
- Chrysil, 161.
- Chrysoma arborescens*; *C. laricifolia*, 156.
- Chrysanthamnus (rabbit brush), 8, 33, 156, 160-163, 179, 180.
bloomer, 156.
glaucus, 163.
lanceolatus (lanceleaf r. b.), 160-161.
nauseosus (rubber r. b.), 161.
nauseosus speciosus, 161.
pulcherrimus, 161.
pumilus, 163.
serrulatus, 163.
speciosus (tall r. b.), 161, 162.
tortifolius, 163.
viscidiflorus (Douglas r. b.), 161-163.
viscidiflorus lanceolatus, 160.
viscidiflorus pumilus (low r. b.), 163.
viscidiflorus serrulatus (sawtooth r. b.), 163.
viscidiflorus tortifolius (twistleaf r. b.), 163.
- Cichoriaceae. *See* Cichorieae.
- Cichorieae, 8, 177-179.
- †Cinnamon (*Cinnamomum zeylanicum*), 38.
- †*Cinnamomum camphora* (camphor-tree); *C. zeylanicum* (cinnamon), 38.
- Cinquefoil, bush (*Dasiphora fruticosa*), 55-57.
shrub (by), 55.
- Cissus incisa (trebine), 114.
- Citron, 91.
- †*Citrus* spp., 91.
- Clark crow, 65.
- Claw, devil's, 71.
- Clawson, A. B., 21, 23, 35, 113, 152, 156, 184, 189.
- Cleavers, 145.
- Clematis, 36, 179.
- Columbia (*C. columbiana*), 36.
columbiana (*Columbia c.*), 36.
verticillaris columbiana, 36.
- Clements, Frederic E., 3, 34, 36, 167, 169, 181.
- Cliffbush (*Edwinia americana*), 9, 39.
- Cliffrose (*Cowania stansburiana*), 6, 7, 49-50.
- Cloudberry (*Rubus chamaemorus*), 57.
- Clover, 141.
- Clubmosses, 126.
- Coachwhip, 115.
- Coast Range, 53, 105, 126, 132.
- Coatl(i), 86.
- Cochetopa National Forest, 175.
- Cochineal scale insect, 118.
- Coleogyne, 3, 7, 55, 180.
ramosissima (blackbrush), 55, 180.
- Coleosanthus (brickellbush), 155.
albicaulis, 155.
californicus (California b.), 155.
floribundus (bigleaf b.), 155.
glabratius, 155.
tener, 155.
- Colorin, 185.
- Colubrina glabra, 111.
texensis, 111.
- Colville National Forest, 146.
- Compositae, 7, 153-179.
- Concentrates, 117.
- Condalia lycioides, 113.
lycioides canescens, 113.
mexicana, 111-113.
obovata (bluewood), 111-113.
obtusifolia, 114.
parryi, 114.
spatulata, 111-113.
- Coneton, 142.
- Conifer family. *See* Conifers.
- Coniferae, 10-12.
- Conifers, 10-12, 26, 48, 55, 63, 98, 102, 105, 107, 111, 119, 120, 121, 124, 126, 135, 146, 150.
- Conner, A. B., 183.
- Cook, O. F., 87, 181.
- Cooperrider, C. K., 4.
- Copple, Robert F., 4, 166.
- Coralbean, western (*Erythrina flabelliformis*), 86.
evergreen, 87.
- Coralberry (*Symphoricarpos orbiculatus*), 9, 149.
- Coraltree (*Erythrina*), 86.
- Cordoncillo, 91.
- Cordwood. *See* Fuel.
- Cornaceae, 119, 122.
- Cornel (sec. or subgenus *Svida*, genus *Cornus*), 63, 119-121, 126.
dwarf, 121.
family. *See* Dogwood family.
red-osier (*Cornus stolonifera*), 121.
waxberry, 121.
western (*C. occidentalis*), 121.
- Cornella, 119, 121.
- Cornus (dogwood; cornel; bunchberry), 119-121, 179.
canadensis (bunchberry), 121.
instolonea, 121.
nuttallii, 179.
occidentalis (western cornel), 121.
pubescens, 121.
stolonifera (red-osier cornel), 121.
stolonifera riparia, 121.
- Corona de Christo, 116.
- Coronado National Forest, 158.
- Corylus (hazel), 19.
californica (California h.), 19, 179.
rostrata (beaked h.), 19.
rostrata californica, 19.
- Cotton (Gossypium), 114, 115.
Arizona wild, 114.
- Cotton, J. S., 33, 181, 189.
- Cottonwood (*Populus* spp.), 9.
- Couch, James F., 34, 35, 107, 181, 184.
- Coulter, John M., 113, 163, 181.
- Coville, Frederick V., 4, 10, 19, 23, 45, 48, 65, 71, 98, 104, 105, 122, 132, 134, 154, 164, 167, 169, 170, 180, 181.
- Covillea, 3, 71, 85, 89-91, 94, 96, 97, 111, 113, 140, 141, 154, 158, 165, 179, 180.
divaricata, 89.
glutinosa, 89.
mexicana, 89.
tridentata (creosote bush), 89-91, 141, 179, 180.
- †Cowage (*Stizolobium pruriens*), 19.
- Cowania, 6, 7, 49-50.
mexicana, 49.
stansburiana (cliffrose), 49-50.
- Cowberry (*Vaccinium vitis-idaea*), 133, 136.

- Coyotillo (*Karwinskia humboldtiana*), 113.
 Crab (apple). *See* Apple, crab.
 Cranberry (*Oxycoccus*); (*O. macrocarpus*), 136.
 European, 136.
 highbush, 153.
 mountain (*Vaccinium vitis-idaea minor*), 136; (*Rhamnus purshiana*), 113.
 small (*O. palustris*), 136.
 western (*O. palustris intermedius*), 136.
 Cranberrybush (*Viburnum* spp.), 152-153.
 American (*V. trilobum*), 153.
 †European (*V. opulus*), 153.
 rayless (*V. pauciflorum*), 153.
 Crataegus (hawthorn), 7, 63-64, 179.
 brevispina, 63.
 douglasii (black h.), 63-64.
 rivularis (river h.), 64.
 Creambush (*Sericotheca discolor*), 58. *See* Oceanspray.
 Creeper, thicket (*Parthenocissus vitacea*), 114.
 Creosote bush. *See* Bush, creosote.
Cronartium ribicola, 41.
 Cronemiller, Fred P., 4.
 Crossidius, 163.
 Crossosoma, 36.
 Croton (crotonweed; croton tree); 93, 94, 180.
 fruticulosus (crotonbush), 93-94.
 neomexicanus, 180.
 Crotonbush (*C. fruticulosus*), 93-94.
 Crow, Clark, 65.
 Crowfoot family. *See* Buttercup family.
 Crown-of-thorns, 116.
 Crown rust (*Puccinia coronata*), 113.
 Crucillo, 113.
 Crystal-tea (*Ledum palustre*), 131.
 Cudweed tribe, 164.
 Culley, Matt J., 4.
 Cupressaceae, 10.
 Cupressus macrocarpa (Monterey cypress), 11.
 Curleaff, 45.
 Currant (*Ribes*), 9, 40, 41-43, 68, 70, 107, 153.
 American black, 43.
 blackhead (*R. americanum*), 43.
 blood, 41.
 cloudcap, 41.
 †European black (*R. nigrum*), 43.
 golden (*R. aureum*), 41.
 gooseberry (*R. montigenum*), 41.
 hairy, 41.
 Indian, 149, 150.
 rock, 41.
 Rothrock (*R. wolffii*), 42-43.
 sandbox, 41.
 squaw (*R. inebrians*), 41.
 sticky (*R. viscosissimum*), 41.
 wax (*R. cereum*), 41.
 winter (*R. sanguineum*), 41.
 Wolf, 42.
 Cyanococcus, 133, 134.
pennsylvanicus, 134.
 Cynoxylon, 119.
 Cypress, Alaska (*Chamaecyparis nootkatensis*), 11.
 Monterey (*Cupressus macrocarpa*), 11.
 Cypress-Juniper-Cedar family, 10.
 Cytisin, 86, 185.
 †Cytisus (broom), 7, 85-86.
 scoparius (Scotch b.), 85-86, 179, 180.
 Daisy, Easter, 165.
 Dalea, 83. *See* Parosela.
 Damiana (*Turnera diffusa*), 166.
 Damanita (*Chrysactinia mexicana*), 166.
 Dandelion, 8.
 Darrow, George M., 41, 181.
 Dasiphora fruticosa (bush cinquefoil), 55-57.
 fruticosa tenuifolia, 57.
 Dasyliion (sotol), 15.
 texanum (Texas s.), 15.
 Datil National Forest, 163.
 Dayton, William A., 10, 165, 182, 186.
 Deer. *See* Wild life.
 DeMoisy, Chas., jr., 4.
Dendromecon rigida, 180.
 Desertbeauty (*Parosela johnsoni*; *P. amoena*), 85.
 Desert-rue (*Thamnosma*), 91-93.
 Mohave (*T. montana*), 91-92.
 Texas (*T. texana*), 92-93.
 Desertwillow (*Chilopsis linearis*), 94, 144.
 Detwiler, S. B., 41, 181.
 Devil's-claw, 71.
 Dewberry (*Rubus* spp.), 57.
 Diervilla lonicera (dwarf bush-honeysuckle), 180.
 Dietz, S. M., 113, 182.
 Dill, Robert, 68, 182.
 Dinsmore, Sanford C., 41, 48, 61, 68, 187.
 Diplacus (bush monkeyflower), 10, 143.
 Diplotaxis, 163.
Dipodomys merriami, 154.
 Distegia, 146, 147.
 involucrata, 147.
 ledebourii, 147.
Distichlis spicata (saltgrass), 34.
 Ditaxis, 93.
 Dixie National Forest, 55, 63, 66, 85, 100, 163.
 Dodonaea (hopbush), 102-104.
 angustifolia, 102.
 schiedeana, 102.
 viscosa angustifolia (hopbush), 102-104, 180.
 Dodonaeaceae, 102-104.
 Dogbane family, 139.
 Dogberry tree, 121.
 Dog fennel, 166.
 Dogweed (*Dysodia*), 165-166.
 prairie (*D. papposa*), 166.
 Dogwood (*Cornus* spp.), 100, 119-121.
 family, 6, 119-122.
 grayleaf, 122.
 herb, 121.
 red-osier, 121.
 western, 121.
 Dondia (seepweed), 36.
 Doten, S. B., 177, 182, 183.
 Douglas, Lynn H., 4.
 Douthitt, Fred D., 4.
 Dracaenaceae, 9, 14-15.
 Dragon-tree family, 9, 14-15.
Drejera thurberi, 144.
 wrightii, 145.
 Drought, 14, 15, 28, 72, 76, 79, 80, 93, 142, 144, 163, 172.
 Drug plants. *See* Medicinal plants.
 Dunes, 86, 89, 160, 166.
 Durrell, L. W., 188.
 Dwarf-indigo, 83.
 Dyes, 86, 81, 82, 83, 138, 179.
 Dysodia (dogweed), 165-166.
 acerosa (prickleleaf), 166.
 chrysanthemoides, 166.
 papposa (prairie d.), 166.
 Dysodia, 165.
 Echinocactus (water cactus; beehive cactus), 180.
 wislizeni (Arizona water c.), 118.
 Echinocereus (hedgehog cactus, etc.), 180.
 Edwinia, 9, 39.
 americana (cliffbush), 39, 180.
 Eggleston, W. W., 4.
 †Eglantine (*Rosa rubiginosa*), 46.
 Elaeagnaceae, 118-119.
 Elaeagnus (silverberry), 118-119.
 argentea. *See* *E. commutata*.
 commutata (silverberry), 118-119.
 Elder (*Sambucus*), 9, 65, 68, 147-149.
 American (*S. canadensis*), 148.
 blackhead (*S. melanocarpa*), 149.
 blueberry (*S. caerulea*), 147-148.
 bunchberry (*S. microbotrys*), 149.
 canyon (*S. vestita*), 148.
 †European red (*S. racemosa*), 149.
 Mexican (*S. mexicana*), 148.
 mountain, 149.
 New Mexican (*S. neomexicana*), 148.
 red, 149.
 red-berried, 149.
 redberry (*S. callicarpa*), 65, 149.
 scarlet (*S. pubens*), 149.
 velvet (*S. velutina*), 148.
 velvetleaf, 148.

- Elderberry. *See* Elder.
 Elk. *See* Wild life.
 Elm family, 25.
 slippery, 115.
 Emergency feed, 14, 15, 80, 116, 117, 124.
 Emplectocladus, 66, 69-70.
 andersonii (Anderson peachbrush), 70.
 fasciculatus (Torrey wild-almond), 70.
 fremontii, 70.
 glandulosus, 70.
 minutiflorus, 70.
 Encelia, 8, 164-165.
 farinosa (white brittlebush), 164-165.
 frutescens, 164.
 starchy, 164.
 Enceliopsis, 164.
 Engler, H. G. A., 10.
 Ensilage, use of browse species for, 14, 15, 89.
 Ephedra (jointfir), 5, 6, 9, 12-13, 116.
 antisiphilitica, 12.
 nevadensis (Nevada j.), 12-13.
 torreyana, 12.
 trifurca, 13.
 viridis, 12.
 Ephedrin, 12.
 Epigaea repens, 180.
 †Erica (heath), 126, 132.
 Ericaceae, 5, 7, 9, 122-133.
 Ericameria arborescens; E. laricifolia; E. palmeri, 156.
 Eriocolin, 131.
 Eriocarpum, 156.
 Eriodictyon (yerba santa), 139-140.
 angustifolium (narrowleaf y. s.), 139-140.
 californicum (California y. s.), 140, 179, 180.
 glutinosum. *See* E. californicum.
 Eriogonum, 9, 27, 82.
 microthecum (slender buckwheatbrush), 27.
 wrightii (Wright buckwheatbrush), 27.
 Erosion, 45, 97.
 control, 36, 51, 80, 89, 112, 115, 116, 121, 126, 144, 154, 155, 156, 158, 179.
 prevention, 20, 22, 114, 115, 121, 126, 127, 160, 179.
 wind, 12, 14, 160.
 Erythrina (coraltree; coralbean), 86, 87.
 flabelliformis (western coralbean), 86.
 Erythrobalanus (subgenus of Quercus), 20, 24-25.
 Escobilla (Buddleia scordioides), 138.
 Estafía (Artemisia frigida), 170-172.
 Euceanothus (sec. of Ceanothus), 105-110.
 Euonymus (burningbushes, wahoos, winter-creepers, etc.), 97.
 atropurpureus (eastern wahoo), 97, 179.
 occidentalis (western wahoo), 97.
 Eupatoriaceae, 155.
 Eupatorium, 156.
 ageratoides, 156.
 tribe, 155.
 urticaefolium, 156.
 Euphorbia crenulata, 93.
 palmeri, 93.
 Euphorbiaceae, 93-94.
 Eurotia, 2, 8, 31-33, 180.
 American, 31.
 lanata (winter fat), 31-33.
 Evonymus. *See* Euonymus.
 Eysenhardtia amorphoides, 86.
 orthocarpa, 86.
 polystachya (kidneywood), 86.
 †Faba vulgaris (horsebean), 79.
 Fabaceae, 7, 82-89.
 Fagaceae, 7, 9, 19-25.
 Fallugia, 7, 50-51.
 paradoxa (Apache plume), 50-51.
 Fallugia, 50.
 False willow, 158.
 False-azalea (Azaleastrum albiflorum), 126, 132.
 False-mesquite (Calliandra eriophylla), 8, 73, 74.
 Featherbush, little, 85.
 Feed, emergency, 14, 15, 80, 116, 117, 124.
 scarcity, 68, 104, 142, 143, 144.
 Fence posts, 20, 25, 76, 77, 144.
 Fendlera (fendlerbush), 9, 39.
 rupicola (cliff f.), 39, 180.
 Fendlerbush (Fendlera), 39.
 cliff (F. rupicola), 39.
 Fendlerella, 39.
 Fennel, dog, 166.
 Fernbush, 55.
 Fetid-marigold, 165, 166.
 Feverbush, California, 122.
 Fiber plants, 14, 115.
 Figwort family, 9, 143-144.
 Fir, Douglas (Pseudotsuga taxifolia), 11, 25, 41, 48, 98, 99, 100, 123, 128, 135, 150.
 †silver (Abies pectinata), 11.
 white (A. concolor), 24, 25, 133, 150.
 Fisher, W. S., 163.
 Fishlake National Forest, 174.
 Fishlake region. *See* Fishlake National Forest.
 Flannelbush (Fremontodendron californicum), 115.
 Fleming, Charles E., 4, 68, 128, 172, 177, 182, 188.
 Flett, J. B., 65, 182.
 Flint, H. R., 4.
 Flory, Charles H., 4.
 Flourensia cernua (tar-bush), 165.
 Flower, Paradise, 71.
 Fogfruit (Phyla), 140.
 Forage analyses, 15, 22, 23, 25, 28, 30, 34, 41, 48, 61, 62, 67, 68, 73, 76, 77, 86, 89, 94, 104, 105, 107, 117, 118, 131, 161, 172.
 Forbes, R. H., 76, 182.
 Forestiera (adelia), 137.
 neomexicana (New Mexican a.), 137.
 Formations, 2-3. *See also* Type (s) and Zones.
 Forsellecia, 5, 97.
 spinescens (greasebush), 97.
 Forsling, Clarence L., 4, 14, 43, 182, 187, 188.
 Foster, Harold D., 4.
 Foster, Luther, 28, 30, 182, 188.
 Fouquieria, 3, 115.
 splendens (ocotillo), 115.
 Fouquieriaceae, 115.
 Foxberry, 136.
 Franseria (bur-sage), 8, 153-154.
 acanthicarpa, 154.
 albicaulis, 154.
 deltoidea (triangle b.-s.), 154, 165.
 dumosa (white b.-s.), 154.
 tenuifolia, 154.
 Fraxinus (ash), 137-138.
 anomala (singleleaf a.), 137.
 attenuata (Toumey a.), 137.
 coriacea (leatherleaf a.), 137.
 cuspidata (fragrant a.), 137.
 oregona (Oregon a.), 138.
 pistaciacefolia, 137.
 toumeyii, 137.
 velutina (velvet a.), 137.
 velutina coriacea, 137.
 velutina toumeyii, 137.
 Fremontia californica, 115.
 Fremontodendron californicum (flannelbush), 115, 179.
 Frijolillo, 87.
 Frijolito, 87.
 Fruit. *See also* Nuts and Seeds.
 edible to—
 birds, 25, 64, 65, 67, 69, 70, 94, 113, 114, 123, 124, 125, 128, 129, 136, 142, 146, 147, 179.
 domestic livestock, 11, 21, 22, 23, 24, 25, 27, 28, 30, 31, 33, 34, 72, 75, 76, 77, 78, 79, 80, 102, 107, 119, 147, 153, 154, 179.
 man, 36, 37, 40, 41, 43, 57, 58, 60, 62, 63, 66, 68, 69, 70, 75, 77, 80, 96, 97, 113, 114, 115, 118, 128, 129, 133, 134, 136, 142, 147, 148, 153, 179.

Fruit—Continued.

- edible to—Continued.
 rodents, game, and other native mammals, 11, 24, 25, 67, 69, 70, 76, 77, 102, 111, 112, 113, 114, 123, 124, 125, 128, 129, 136, 142, 179.
 fiber-bearing, 114, 115.
 medicinal, 19, 179.
 morphological characters, 20, 21, 49, 64, 82, 105, 107.
 poisonous, 11, 86, 102, 104, 107, 113, 150, 152.
 saponaceous, 104.
 Frye, Theodore C., 188.
 Fuel, 20, 25, 76, 77, 80, 85, 87, 91, 104, 116, 137, 168, 169, 179. *See also* Fence posts.
 Furze, 89.
 Gaertnera, 153.
 Gaertneria, 153, 154.
deltoidea, 154.
dumosa, 154.
 Galium (bedstraw), 145–146.
 Galls, 25, 160, 178, 179.
 Game. *See* Wild life.
 Garambullo, 113, 142.
 Garrya (silk-tassel), 24, 69, 103, 121–122, 124, 179.
elliptica (tasseltree), 122.
flavescens (yellowleaf s.), 121.
fremontii (Frémont s.), 121.
goldmanii (Goldman s.), 122.
wrightii (Wright s.), 122.
 Gatuño, 79.
 Gaultheria (wintergreen), 122, 128, 179.
humifusa (western w.), 128.
myrsinites. *See* G. humifusa.
ovatifolia (bush w.), 128.
procumbens (w.), 128.
shallon (salal), 128, 129, 179.
 Gaylussacia (huckleberry), 133.
 Geraea, 164.
 Geranium, 68.
 Gilia, 82, 139.
Nuttall (*Leptodactylon nuttallii*), 139.
nuttallii, 139.
prickly (*Leptodactylon pungens*), 139.
pungens, 139.
 white. *See* Gilia, Nuttall.
 Girasol-thorn, 79.
 Girola, Carlos D., 158, 182.
 Glasswort (*Salicornia*), 36.
 Globe-flower, 145.
 Globemallow (*Sphaeralcea*), 115.
 Glossopetalon, 97.
 Glover, George H., 67, 68, 128, 157, 182, 188.
 Glucosides, 11, 45, 122, 131, 145, 172.
 Gnaphaliaceae, 164.
 Gnetaceae, 9, 12–13.
 Goat-berry, 94.
 Goatbrush, 98.
 Goats, 9, 11, 12, 16, 18, 21, 22, 23, 24, 25, 27, 33, 34, 39, 41, 43, 45, 46, 48, 50, 51, 53, 55, 57, 60, 63, 67, 69, 70, 76, 79, 85, 86, 87, 91, 92, 93, 94, 96, 104, 107, 108, 109, 110, 111, 113, 114, 115, 121, 122, 123, 124, 125, 134, 135, 137, 138, 140, 141, 142, 144, 145, 150, 152, 153, 158, 160, 165, 167, 168, 169, 176.
 wild, 94.
 Gobernadora, 89.
 Goldenfleece (*Aplopappus arborescens*), 156.
 Goldenweed (*Aplopappus*), 156–157.
singlehead (*A. suffruticosus*), 157.
whitestem (*A. macronema*), 157.
 Goldman, Edward A., 71, 166, 182.
 Golondrilla, 138.
 Goodspeed, Thomas Harper, 161, 183.
 Gooseberry (*Grossularia*), 9, 40–41.
 comon wild, 40.
 false, 41.
 family, 9, 40–43.
Lobb (*G. lobbia*), 41.
orange (*G. pinetorum*), 41.
redshoot (*G. setosa*), 40–41.
showy (*G. speciosa*), 41.

Gooseberry—Continued.

- Sierra (*G. roezli*), 40.
 smooth, 40.
 thicket (*G. divaricata*), 40–41.
 Watson (*G. watsoniana*), 40.
 whitestem (*G. inermis*), 40.
 wine, 40.
 Goosefoot family, 6, 7, 8, 27–36.
 †Gorse (*Ulex europaeus*), 89.
 Gossypium (cotton), 114.
 Grama (*Bouteloua*), 39, 73, 82, 138.
 black (*B. eriopoda*), 14.
 blue (*B. gracilis*), 32, 169.
 Grand Canyon (region), 45, 50, 119.
 Grandjean, E., 4.
 Grape (*Vitis*), 179.
 family, 114.
 Oregon. *See* Hollygrape.
 Grass(es), 53, 150. *See also* Type(s).
 goose, 145.
 curly mesquite, 73.
 June, 169.
 Gray, Asa, 165, 181.
 Grayia (hop-sage), 8, 33–34.
brandegei (spineless h.-s.), 33–34.
polygaloides, 33.
spinosa (spiny h.-s.), 33.
 Grazing reconnaissance. *See* Range reconnaissance.
 Greasebrush, 97.
 Greasebush (*Forsellia spinescens*), 97.
(Ceanothus cuneatus), 111.
 Greasewood (*Sarcobatus vermiculatus*), 2, 8, 31, 32, 34–36, 53.
(Atriplex canescens), 28.
(Covillea tridentata), 89.
(Tetradymia glabrata), 176.
 Bailey (*S. baileyi*), 34.
 black, 34.
 false, 83.
 white, 28.
 Greene, Edward L., 4, 70, 182.
 Greshoff, M., 45, 73, 104, 147, 150.
 Griffiths, David, 27, 90, 117, 118, 152, 176, 179, 182, 183.
 Grinnell, George Bird, 188.
 Grossularia (gooseberry), 40–41, 179.
divaricata (thicket g.), 40–41.
inermis (whitestem g.), 40.
lobbia (Lobb g.), 41.
pinetorum (orange g.), 41.
roezli (Sierra g.), 40.
setosa (redshoot g.), 40–41.
speciosa (showy g.), 41.
watsoniana (Watson g.), 40.
 Grossulariaceae, 9, 40–43.
 Groundsel (*Senecio*), 8, 176.
 bush, 160.
 seashore, 160.
 tribe, 176–177.
 Groundsel-tree (groundsel tree), 158, 160.
 Guayule (*Parthenium argentatum*), 165.
 Guelder-rose, wild, 153.
 Gutierrezia (snakeweed), 8, 163–164, 180.
diversifolia, 163.
euthamiae, 163.
filifolia, 164.
linearis, 163.
longifolia, 163.
microcephala (threadleaf s.), 164.
sarothrae (broom s.), 163, 180.
tenuis, 163.
 Guttertree, 121.
 Gymnolomia, 165. *See* Viguiera.
 Hackberry (*Celtis*), 25–26, 77, 103.
 Douglas (*C. douglasii*), 25, 26.
 netvein, 25.
 spiny (*C. pallida*), 25.
 Hadwen, Seymour, 15, 18, 19, 131, 136, 183.
 Hagweed, 85.
 Hall, E. R., 17, 21.
 Hall, Harvey Monroe, 67, 130, 143, 161, 183.
 Halsted, B. D., 11.
 Hanson, Herbert C., 115, 183, 188.
 Haplopappus, 156.
 Hard-tack, 43.

- Hare, R. F., 117, 118, 183.
 Harshberger, John W., 2, 183.
 Hart, George H., 107.
 Hatton, John H., 4, 109, 124, 131, 183.
 Havard, V., 76, 89, 104, 183.
 Haw, black, 63.
 Douglas, 63.
 purple, 112.
Hawthorn (*Crataegus*), 7, 63-64, 68.
 black (*C. douglasii*), 63.
 Douglas, 63.
 river (*C. rivularis*), 64.
 short-spined, 63.
Hazel (*Corylus*), 9, 19, 69.
 beaked (*C. rostrata*), 19.
 California (*C. californica*), 19, 106.
 Heart-nut, 82.
 †Heath (*Erica*), 126, 132, 166.
 family, 5, 7, 9, 122-133.
 mountain (*Phyllodoce*), 132.
 Brewer (*P. breweri*), 132.
 cream (*P. glanduliflora*), 132.
 red (*P. empetriflora*), 132.
 †Heather (*Calluna vulgaris*), 126, 132.
 Hedge plants, 91.
Hedgehog cactus (*Echinocereus* spp.), 180.
 Hediondilla, 89.
 Helenieae, 166.
 Heliantheae, 164-166.
 Helm, Harley J., 4.
 Hemlock, 132, 133.
 Henkel, Alice, 145, 148, 153, 183.
 Henry, Joseph Kaye, 188.
 Heppner, F. E., 33, 184.
 Hill, Robert R., 4, 10, 183.
 Hills, golden, 164.
 Hippocastanaceae, 102.
Hippomane mancinella (manchineel), 93.
 Hogs. *See* Swine.
Holacantha emoryi, 116.
Hollygrape (*Odotemon*), 36-37, 48.
 creeping (*O. repens*), 37.
 Fremont (*O. fremontii*), 37.
 Oregon (*O. aquifolium*), 37, 128.
 red (*O. haematocarpus*), 37.
Holodiscus discolor, 58.
 dumosus, 58.
 Holy-rose, marsh, 122.
 Honey (plants). *See* Bee plants.
 Honeyballs, 145.
Honeysuckle (*Lonicera*), 146-147.
 (*Anisacanthus thurberi*), 144.
 bearberry (*L. involucrata*), 146-147.
 bush, 147.
 chaparral (*L. interrupta*), 147.
 family, 7, 9, 146-153.
 fly, 146.
 involucrated, 146.
 Ledebour (*L. ledebourii*), 147.
 timber, 147.
 Utah (*L. utahensis*), 147.
Hopbush (*Dodonaea viscosa angustifolia*), 102-104.
 Hops, 91.
Hop-sage (*Grayia*), 8, 33-34.
 spineless (*G. brandegei*), 33-34.
 spiny (*G. spinosa*), 33.
Hoptree (*Ptelea*), 91.
 common (*P. trifoliata*), 91.
 Hornaday, William T., 80, 164, 183.
 Hornbrush (sec. *Cerastes*, genus *Ceanothus*), 104, 105.
 Gregg (*Ceanothus greggii*), 111, 112.
 wedgeloaf (*C. cuneatus*), 69, 111.
 †Horsebean (*Vicia faba*), 79.
 (*Parkinsonia aculeata*), 79.
Horsebrush (*Tetradymia*), 176-177.
 (*Grayia spinosa*), 33.
 (*Parthenium incanum*), 165.
 littleleaf (*T. giabrata*), 176-177.
 longspine (*T. axillaris*), 177, 178.
 Nuttall (*T. nuttallii*), 177.
 shortspine (*T. spinosa*), 177.
 spineless (*T. canescens inermis*), 177, 178.
Horsechestnut (*Aesculus*; *A. hippocastanum*), 102.
 Horses, 11, 21, 33, 34, 37, 46, 48, 49, 53, 66, 72, 76, 79, 83, 85, 86, 87, 102, 109, 114, 134, 138, 139, 154, 156, 158, 160, 163, 164, 166, 167, 172, 175, 176.
 Horsetail, shrubby, 12.
Horsfordia newberryi, 114.
 Hough, Romeyn Beck, 188.
 Howard, Charles D., 67, 69, 184.
 Howell, Thomas, 188.
 Hoyle, Mrs. Annie E., 4.
Huckleberry (*Gaylussacia*). *See* Blueberry.
 dwarf, 135.
 high (bush), 133.
 family, 9. *See* Blueberry family.
 fools', 131.
 large, 133.
 medium, 134.
 red, 135.
 small, 134, 135.
 small-leaved, 135.
 swamp, 134.
 tall red, 135.
 thinleaf, 133.
 Humble, Cleveland W., 188.
 Humus, 34, 46, 48, 135.
 Hurst, C. H., 4.
 Hurtt, Leon C., 4, 188.
Hydrangea arborescens (smooth h.), 153.
 family, 9, 39-40.
 Hydrangeaceae, 9, 39-40.
 Hydrocyanic acid, 45, 67, 68.
 Hydrophyllaceae, 139-140.
 Hylcoereus (nightblooming cereus), 118.
 Hymenatherium; *H. acerosum*, 165-166.
 Hymenoclea, 8, 103, 154.
 monogyra (barrobrush), 154, 179, 180.
 Hypericum, 180.
 Hyptis, 9, 140, 141.
 emoryi (Emory bushmint), 141.
 lanata, 141.
Ilex verticillata, 179.
 Iliamna, 115.
 Ictenoso, 164.
 Indicator plants, 83, 89, 90, 160, 164, 167, 168, 169, 170, 171, 180.
Indigo, American (*Indigofera suffruticosa*), 83.
 †true (*Indigofera tinctoria*), 83.
Indigobush (*Amorpha*; *A. fruticosa*), 82-83.
 (*Psoralea spinosa*), 85.
 California (*A. californica*), 83.
 desert (*A. occidentalis*), 83.
 dwarf (*A. nana*), 83.
Indigofera (indigo), 83.
 amil, 83.
 suffruticosa (American i.), 83.
 †*tinctoria* (true i.), 83.
Ingenhouzia triloba, 114.
 Ingram, Douglas C., 4, 63, 70, 98.
 Inkberry, 146.
 Insects, 102, 131, 173. *See also* Bee plants; galls.
 cochineal, 118.
 destructive to browse spp., 163.
 Iodine-weed, 36.
 Ironwood, 86, 137.
 desert, 86.
 Mexican, 86.
 Sonora, 86.
 Isocoma, 156. *See* Aplopappus.
 coronopifolia, 157. *See* *A. fruticosus*.
 fruticosa, 157. *See* *A. fruticosus*.
 veneta, 156. *See* *A. venetus*.
 wrightii, 156. *See* *A. heterophyllus*.
 Ivy, poison (*Toxicodendron* spp.), 96, 97.
 western (*T. rydbergii*), 97.
 Jaboncillo, 104, 140.
 Jackson Hole (region), 33, 170.
Jamea americana, 39.
 Jano, 144.
 Jardine, James T., 4, 188.
 Jasmine, bastard, 142.
Jatropha (nettle-spurge, etc.), 93.
 Jay, Oregon, 65.
 Jepson, Willis Linn, 19, 27, 31, 65, 102, 131, 133, 143, 148, 183.
 Jersey-tea, inland (*Ceanothus ovatus*), 109.
 Jerusalem-thorn (*Parkinsonia aculeata*), 8, 79.

- Jessamine, bastard, 142.
 Jimmyweed (*Aplopappus heterophyllus*), 8, 156-157.
 Johnson, E. P., 67, 156, 183.
 Johnston, I. M., 80, 183.
 Jointfir (*Ephedra*), 6, 12-13.
 family, 9, 12-13.
 Nevada (*E. nevadensis*), 12.
 Jojoba (*Simmondsia californica*), 5, 9, 94, 95, 165.
 Jones, J. M., 183.
 Jornada Range Reserve, 163.
 Judas-tree, 80.
 Judd, C. S., 87, 184.
Juglans spp., 179.
 Juices (browse plants), 6, 93, 97, 107, 121, 145, 177. *See also* Poisonous species.
 Jujube (*Zizyphus*), 113-114.
 †common (*Z. jujuba*), 113.
 Parry (*Z. parryi*), 114.
 Southwestern (*Z. lycioides*), 113.
 Texas (*Z. obtusifolia*), 114.
 Junco, 116.
 Juneberry, western, 124.
 June grass. *See* Grass, June.
 Juniper (*Juniperus*), 2, 3, 11, 22, 37, 39, 43, 50, 55, 66, 70, 91, 96, 111, 122, 137, 139, 141, 155, 158.
 alligator (*J. pachyphloea*), 11.
 Colorado, 11.
 common, 11.
 dwarf (*J. communis*), 11.
 one-seed (*J. monosperma*), 11.
 Utah (*J. utahensis*), 11.
 Virginia, 11.
 western (*J. occidentalis*), 11.
 Juniperaceae, 10.
 Juniperus (juniper), 11.
 communis (dwarf j.; common j.), 11, 179.
 monosperma (one-seed j.), 11.
 occidentalis (western j.), 11.
 pachyphloea (alligator j.), 11.
 scopolorum (Rocky Mountain red cedar), 11.
 utahensis (Utah j.), 11.
 virginiana (eastern red cedar), 11.
 Kaibab National Forest, 17, 21, 50, 87.
 Kaibab Plateau, 50, 163.
 Kalmia, 128-130.
 alpine (*K. microphylla*), 128, 130.
 alpine bog, 128.
 bog (*K. polifolia*), 129-130.
 dwarf. *See* Alpine k.
 glauca. *See* K. polifolia.
 glauca microphylla. *See* K. microphylla.
 microphylla (alpine k.), 128, 130, 180.
 occidentalis. *See* K. polifolia.
 polifolia (bog k.), 129-130.
 polifolia microphylla. *See* K. microphylla.
 Karwinskia humboldtiana (coyotillo), 113.
 Keeler, Harriet L., 83, 184.
 Kellogg, R. S., 77, 184.
 Kelly, J. W., 12, 180.
 Kennedy, P. Beveridge, 41, 48, 61, 68, 187, 188.
 Kiahapoko, 164.
 Kidney-root, 160.
 Kidneywood (*Eysenhardtia polystachya*), 86.
 Kidneywort (*Baccharis pilularis*), 160.
 Kinnikinnick. *See* Bearberry.
 Knight, Henry G., 33, 157, 184.
 Knowles, Louis, 4.
 Kochia americana (green moll), 36.
 Koerberliniaceae, 115-116.
 Koerberlinia spinosa (all-thorn), 116.
 Korstian, Clarence F., 4, 188.
 Krameria (ratany), 80-82.
 canescens, 82.
 glandulosa (range r.), 81, 82.
 grayi (white r.), 82.
 parvifolia (littleleaf r.), 82, 179.
 secundiflora (trailing r.), 82.
 Krameriaceae, 7, 8, 80-82.
 Kuhns, John C., 4.
 Kunzé, Richard E., 13, 71, 80, 91, 184.
Kunzia tridentata, 53. *See* *Purshia tridentata*.
 Labrador-tea (*Ledum*), 9, 130-131.
 smooth (*L. glandulosum*), 131.
 true (*L. groenlandicum*), 131.
 Lambing range, 170, 171, 172, 173.
 Lambs, 23, 27, 128, 131, 172.
 Lameta, 94.
 Lantow, J. L., 28, 30, 182.
 Larch (*Larix*), 11, 48, 99, 132.
 †European (*L. decidua*), 11.
 western (*L. occidentalis*), 48, 99, 132.
 Larix (larch), 11, 48, 99, 132.
 †*decidua* (European l.), 11.
 europaea, 11.
 occidentalis (western l.), 48, 99, 132.
 Larrea, 89.
 La Sal region, 63.
 Lassen National Forest, 109, 124.
 Latex, 4, 179.
 Lauraceae, 38-39, 126.
 †Laurel (*Laurus*), 38, 126, 128. *See also* California-laurel.
 (*Kalmia* spp.), 128.
 American, 128.
 black (*Leucothoe davisiae*), 131, 146.
 Coos Bay, 39.
 European, 38.
 family, 38-39, 126, 128.
 †Grecian (*L. nobilis*), 38.
 mountain. *See* Mountain-laurel.
 pale, 129.
 sheep, 126.
 sticky, 109.
 swamp, 128.
 "Laurels," 9.
 Laurel-cherry (sec. *Laurocerasus*, genus *Prunus*), 66, 67.
 Laurocerasus (laurel-cherry; cherry-laurel, sec. *Prunus*), 66.
 †*Laurus* (laurel), 38, 128.
 †*nobilis* (Grecian l.), 38.
 Lava (lava beds), 55, 66, 138, 139, 167, 177.
 Lavatera (treemallow), 115.
 assurgentiflora (California t.), 115.
 Lawrence, William E., 67, 126, 132, 184.
 Leadplant (*Amorpha canescens*), 2, 83.
 Leaf decoctions, 169.
 hairs (structure of), 164.
 infusions, 158.
 types, 54, 55, 164.
 Leatherwood, mountain, 115.
 Ledges, limestone, 97.
 Ledum (Labrador-tea, etc.), 3, 130-131.
 glandulosum (smooth L.-t.), 131, 180.
 groenlandicum (true L.-t.), 131.
 palustre (crystal-tea), 131.
 Legumes, 18. *See* Bean family.
 Leguminosae. *See* Fabaceae.
 Lemita, 96, 97.
 †Lemon-verbena (*Lippia citriodora*), 140.
 Lennoaceae, 154.
 Lenzie, Frank B., 4, 40, 98, 128, 132, 134.
 Leopold, Aldo, 188.
 Lepargyrea (buffaloberry), 119, 120, 179.
 argentea (silver b.), 119, 120, 179.
 canadensis (russet b.), 119, 120, 179.
 rotundifolia (roundleaf b.), 119, 120.
 Leptodactylon (gilia), 139.
 brevifolium, 139.
 nuttallii (Nuttall gilia), 139.
 pungens (prickly gilia), 139.
 Leucobalanus (subgenus of *Quercus*), 20, 21-24.
 Leucothoe davisiae (black laurel), 131, 180.
 Liebig, Frank F., 4.
 Lignum nephriticum, 86.
 Lilac, 105.
 wild, 155.
 Liliaceae, 9, 14.
 Lily family, 9, 14.
 Limestone areas, 50, 98, 100.
 hills, 88.
 ledges, 97.
 soils. *See* Soils, limestone.

- Lincoln National Forest, 85, 94, 158.
 Linden, 141.
 Linnaea (twinflower), 146.
 americana, 146.
 borealis, 146.
 borealis americana (American t.), 146.
 Linnaeus, Carolus (Karl von Linné), 118.
 Linyris, 156, 157, 160. *See* Aster and Chrysomellus.
heterophyllus, 156.
 Lippia, 140.
 citriodora (lemon-verbena), 140.
 ligustrina (privet l.), 140.
 lycoides. *See* *L. ligustrina*.
 privet (*L. ligustrina*), 140.
 triphylla. *See* *L. citriodora*.
 Wright (*L. wrightii*), 140.
 wrightii (*L. wrightii*), 140.
 Lister, P. B., 4.
 Lithocarpus densiflorus (tanoak), 19-20.
 densiflorus echinoides (scrub t.), 19-20.
 Lithraea, 96.
 Lobadium, 96.
 Locust (Robinia), 7, 83, 87.
 black (*R. pseudoacacia*), 87.
 common, 87.
 mountain, 86.
 New Mexican (*R. neomexicana*), 87.
 river, 83.
 Rusby (*R. rusbyi*), 87.
 Loganiaceae, 138.
 Logania family, 138.
 Logwood, 112.
 Lomasson, Thomas, 4.
 Long, Harold C., 11, 67, 184.
 Long, W. H., 188.
 Longtube (Macrosiphonia), 139.
 Arizona (*M. brachysiphon*), 139.
 Loniceria (honeysuckle), 133, 146-147, 180.
 interrupta (chaparral h.), 147.
 involuta (bearberry h.), 146-147.
 involuta ledebourii, 147.
 ledebourii (Ledebour h.), 147.
 utahensis (Utah h.), 147.
 Lophophora williamsii (peyote), 118.
 Lorantheae, 26-27.
 Lote-bush, 114.
 Lotus, 82.
 Lover, mountain, 98.
 Lumboltz, Carl, 87.
 Lupine (Lupinus), 68, 69, 82, 106, 107, 133, 150.
 shrub, 3.
 Lycium (wolfberry; matrimony-vine), 142, 179, 180.
 fremontii (Frémont w.), 142.
 halimifolium (m.-v.), 142.
 pallidum (pale w.), 142.
 vulgare, 142.
 Lygodesmia (skeletonplant), 8, 177-179.
 juncea (rush s.), 178-179.
 spinosa (thorn s.), 179.
 Lyons, Albert B., 26, 28, 91, 104, 131, 142, 145, 148, 153, 158, 160, 169, 184, 187.
 MacKenzie, Thomas P., 170, 171.
 Mackie, W. W., 22, 23, 25, 184.
 Macronema, 156. *See* Aplopappus.
 discoideum, 157.
 lineare, 157.
 suffruticosum, 157.
 Macrosiphonia (longtube), 139.
 brachysiphon (Arizona l.), 139.
 Madder family, 145-146.
 Madrone (Arbutus), 9, 123.
 Arizona (*A. arizonica*), 123.
 Mexican (*A. xalapensis*), 123.
 Pacific (*A. menziesii*), 123.
 Texas (*A. texana*), 123.
 Madroño. *See* Madrone.
 Magee, Jack, 4.
 Mahala-mats, 111.
 Mahogany. *See* Mountain-mahogany.
 birchleaf, 43.
 Mahonia, 36.
 Mairania alpina (ptarmiganberry), 124.
 Malaceae, 7, 60-65.
 Malache lasiopetala (Wright pavonia), 114.
 Mallow family, 6, 114-115.
 Malmsten, Harry E., 4, 152, 186.
 Malus (apple; crab apple), 65-66.
 fusca (Oregon c. a.), 65-66.
 Malvaceae, 114-115.
 Malvastrum, 115.
 Malvaviscus drummondii (Drummond waxmal-low), 114.
 Mamullaria, 180.
 Manchineel (Hippomane mancinella), 93.
 †Mangifera indica (mango), 95.
 Mangle, 85.
 †Mango (*Mangifera indica*), 95.
 Manihot (cassava, etc.), 93.
 Manti National Forest, 66, 149.
 Manti region (Wasatch Mountains, Utah), 66.
 Manzanilla, 114.
 Mazanita (Arctostaphylos), 9, 24, 43, 60, 69, 109, 122, 123-126.
 greenleaf (*A. patula*), 124.
 pinemat. *See* Pinemat.
 pointleaf (*A. pungens*), 124.
 Maple (Acer), 9, 46, 60, 68, 98-102.
 ashleaf, 98, 102.
 bigleaf (*A. macrophyllum*), 98, 100-102, 107.
 bigtooth (*A. grandidentatum*), 100, 101.
 Douglas (*A. douglasii*), 98, 99, 100.
 dwarf, 98, 100.
 family, 98-102.
 mountain, 98, 100.
 Oregon, 100.
 rock, 98.
 Rocky Mountain (*A. glabrum*), 98-100.
 shortwing, 100.
 Southwestern (*A. brachypterum*), 99, 100.
 sugar (*A. saccharum*), 98.
 vine (*A. circinatum*), 99, 100.
 Margareta, 113.
 Mariola (Parthenium incanum), 165.
 Maris, H. B., 4.
 Marsh, C. Dwight, 21, 23, 35, 37, 67, 84, 86, 113, 126, 131, 132, 152, 156, 157, 158, 184, 189.
 Marsh, Hadleigh, 21, 23, 184.
 Martineau, Bryant S., 4, 134.
 Mast, 21, 22, 23, 24, 25.
 losses from, 22.
 Mast, William H., 5.
 Matiola, 165.
 †Matrimony-vine (*Lycium halimifolium*), 142.
 Maximowicz, Karl Johann, 57.
 Mayweed tribe, 166-176.
 †Mazzard (*Prunus avium*), 66.
 McCreary, Otto, 188.
 McDonald, Charles H., 4.
 McNair, (Miss) Agnes D., 4.
 Meadowrue, 65.
 Meadows, 40, 57, 120, 134, 135.
 Meadowsweet, 60.
 Mearns, Edgar Alexander, 189.
 Mecs, 163.
 Medicinal plants, 12, 13, 27, 37, 54, 73, 80, 81, 82, 91, 92, 93, 96, 98, 113, 114, 118, 121, 123, 128, 131, 136, 138, 139, 140, 142, 146, 147, 148, 153, 154, 156, 158, 160, 164, 166, 168, 169, 172, 173, 175, 176, 179.
 Medicine Bow National Forest, 158.
 Medicus, Friedrich Casimir, 57.
 Melampodium (blackfoot), 165.
 leucanthum (plains h.), 165.
 plains, 165.
 †Melia azedarach (chinaberry), 104.
 Melochia pyramidata, 115.
 Menodoropsis longiflora. *See* Menodora longiflora.
 Menodora laevis (smooth m.), 138.
 longiflora (showy m.), 138.
 rough (*M. scabra*), 138.
 scabra (rough m.), 138.
 showy (*M. longiflora*), 138.
 smooth (*M. laevis*), 138.
 Menthaceae, 9, 140-142.

- Menziesia**, 9, 131-132, 180.
 ferruginea (rusty m.), 131-132, 180.
 glabella (smooth m.), 132, 180.
 rusty (*M. ferruginea*), 131-132.
 smooth (*M. glabella*), 132.
Merrill, Ruth Earl, 19, 184.
Messas, 27, 50, 71, 82, 116, 138, 140, 165, 167.
Mescal. *See* Peyote.
Mescalbean (*Sophora secundiflora*), 7, 87-89.
Mescal, 71.
Mesenna (*Albizia anthelmintica*), 73.
Mesospaerum emoryi. *See* *Hyptis emoryi*.
Mesquite (*Prosopis*), 8, 26, 32, 71, 73-77, 82, 85, 87, 113, 139, 144, 154, 165.
 bastard, 73, 85.
 common (*P. juliflora*), 76-77.
 dwarf (ed.), 71.
 glandular, 74.
 honey (*P. glandulosa*), 74-76.
 prairie, 74.
 screwbean, 77.
 velvet (*P. velutina*), 76-77.
Mexican-buckeye (*Ungnadia speciosa*), 104.
Mexican-orange, 91.
Midgewort, 167.
Miles, Lee O., 4.
Milfoil, chaparral, 55.
Milk, effect of browse on, 27.
Milk sickness, 156.
Milkwort family, 93.
Millefolium, chaparral, 55.
Miller, M. R., 30, 68, 177, 182, 188.
Mimosa (*mimosa*; sensitiveplant), 8, 77-79.
 buncifera (catclaw m.), 79.
 catclaw (*M. buncifera*), 79.
 dysocarpa (velvetpod m.), 79.
 family, 7, 8, 71-79.
 fragrans (fragrant m.), 79.
 fragrant (*M. fragrans*), 79.
 paired-thorn, 79.
 spudica, 8.
 unguis-cati, 71.
 velvetpod (*M. dysocarpa*), 79.
Mimosaceae, 7, 8, 71-79.
Mimulus (monkeyflower), 143.
Minnie-bush, 131.
Mint family, 9, 140-142.
Mio mio (*Baccharis coridifolia*), 158.
Misery, mountain, 55.
Mistletoe, American (*Phoradendron flavescens*), 27.
 family, 26-27.
Mitchell, A. (Medical Corps, U. S. A.), 113.
Moats, water, 158.
Mockorange (*Philadelphus*), 40, 100.
 Lewis (*P. lewisii*), 40.
Modesty, 40.
Modoc National Forest. *See* Modoc region.
Modoc region (n. e. California), 46, 66, 138, 147, 177.
Mohave Desert, 3, 34, 55, 141.
Mohave-thorn, 116.
Molly, green (*Kochia americana*), 36.
Monillo, 104.
Monkeyflower (*Mimulus*), 143.
 bush (*Diplacus*), 143.
Monnina wrightii, 93.
Moore, George E., 4.
Moorwort, 122.
Mormon-tea, 12.
Morse, Fred W., 67, 69, 184.
Mortonia, 98.
Morus, 179.
Moss-heather, 126.
Mossplant, 126.
Motie, water, 158.
Mountain-ash (*Sorbus*), 7, 64-65, 133.
 alpine (*S. occidentalis*), 64-65.
 American (*S. americana*), 65.
 Greene (*S. scopulina*), 65.
 Pacific (*S. sitchensis*), 65.
 Siberian (*S. sambucifolia*), 64.
Mountain heath (*Phyllodoce*). *See* Heath, mountain.
Mountain-lilac, tall, 109.
Mountain-laurel, 39, 87, 126.
Mountain-mahogany (*Cercocarpus*), 2, 7, 24, 43-46, 50, 53, 122, 124, 138, 150, 158.
 Arizona (*C. arizonicus*), 46.
 birchleaf (*C. betuloides*), 45.
 curlleaf (*C. ledifolius*), 45.
 silver (*C. argenteus*), 45.
 trunc (*C. montanus*), 43-45.
 Wright (*C. breviflorus*), 46.
Mountainweed, white, 139.
Mount Hood region, 23, 70.
Mozzina, 93.
Mucuna, 19. *See* *Stizolobium*.
Mueller, Ferdinand Von, 27.
Mugwort, 167, 173, 175.
 California, 173.
 dark-leaved, 175.
 Louisiana, 175.
 Mexican, 175.
 New Mexican, 175.
Muhlenbergia, 39.
Munns, E. N., 55, 184.
Mutisia subfamily, or tribe, 153.
Mutisiaceae, 153.
Mutisieae, 153.
Myrica (*bayberry*; *waxmyrtle*), 179.
Myrtle, 105.
 Oregon, 39.
Myrtlebush, 98.
Nannyberry (*Viburnum lentago*), 153.
 (*Lepargyrea canadensis*), 119.
Nannybush, 153.
Needle grass (*Stipa*), 169.
 small (*S. columbiana*), 161.
Negundo (sec. genus *Acer*), 98, 102.
Nelson, Aven, 31, 33, 157, 163, 170, 172, 177, 181, 184.
Nelson, Elias E., 30, 31, 185, 189.
Nelson, Enoch W., 4, 43.
Neostyphonia, 96.
Nicotiana (*tobacco*), 142-143.
 glauca (tree t.), 142-143, 180.
Ninebark (*Opulaster*), 7, 57, 68.
 (*Dasiphora fruticosa*), 55.
 mallow (*O. malvaceus*), 57.
Nio nio, 158.
Nitrogen-fixing bacteria, 18.
Nolina (*sacahuista*), 15.
Nopal (*Nopalea cochenillifera*), 118.
Nopalea cochenillifera (*nopal*), 118.
Nucifraga columbiana (Clark crow), 65.
Nurse crops for timber reproduction, 16, 105, 121, 124.
Nutbrush, 94.
Nuts, 4, 19, 179. *See also* Fruits; Seeds.
Oak (*Quercus*), 2, 7, 9, 19, 20-25, 26, 39, 46, 65, 69, 111, 122, 124, 138, 144, 150, 158.
 Arizona, 22.
 Arizona white (*Q. arizonica*), 22.
 black, 20, 24, 25.
 blackjack, 25.
 Brewer (*Q. oerstediana*), 23.
 brush, 53, 68, 96, 97, 144. *See also* Types.
 California, 25.
 California black (*Q. kelloggii*), 25, 107.
 California mountain white, 23.
 California scrub (*Q. dumosa*), 22-23.
 canyon, 24.
 canyon live (*Q. chrysolepis*), 24.
 chestnut, 20, 24. *See* Oak, groups, chestnut.
 Emory (*Q. emoryi*), 25.
 family, 7, 9, 19-25.
 Fendler (*Q. fendleri*), 23.
 Gambel (*Q. gambelii*), 21, 23, 43, 60.
 Garry (*Q. garryana*), 23.
 golden-cup, 24.
 gray (*Q. grisea*), 5, 22.
 groups, 20-21.
 black. *See* red.
 chestnut, 20, 24.
 intermediate (sec. *Protobalanus*), 20, 24.
 live, 20, 22, 50, 123.
 red (sec. *Erythobalanus*), 20, 24-25.

- Oak—Continued.
 groups—Continued.
 shinnery (shin), 20, 23–24.
 white (sec. *Leucobalanus*), 20, 21–24.
 Havard (*Q. havardii*), 23.
 hedgehog, 19.
 huckleberry (*Q. vaccinifolia*), 24.
 Kellogg, 25.
 live, 20, 22, 50, 123.
 maul, 24.
 Mexican white, 24.
 netleaf (*Q. reticulata*), 24.
 New Mexican (*Q. novomexicana*), 21–22.
 Oregon chestnut, 24.
 Oregon white, 23.
 poison (*Toxicodendron diversilobum*), 21, 96, 97.
 red, 20, 24, 25.
 Rocky Mountain shin, 23.
 Rocky Mountain white, 21.
 Sadler (*Q. sadleriana*), 24.
 scrub, 111, 144, 158.
 shin, 23.
 shinnery, 23.
 shrub live (*Q. turbinella*), 23.
 tan. *See* Tanoak.
 tanbark, 20.
 Utah (*Q. utahensis*), 21–22.
 Vreeland (*Q. vreelandii*), 21–22.
 wavyleaf (*Q. undulata*), 23–24.
 Wilcox (*Q. wilcoxii*), 24.
 Oakley, R. A., 189.
 Oats, browse species involved in rust of, 113.
 Oceanspray (*Sericotheca discolor ariaefolia*), 48, 49, 58, 59.
 Ocotillo (*Fouquieria splendens*), 115.
 family, 115.
 Odors (browse plants), 41, 67, 70, 71, 83, 87, 89, 91, 105, 107, 111, 116, 126, 127, 130, 137, 138, 139, 140, 141, 166.
 Odostemon (hollygrape), 36–37, 179, 180.
 aquifolium (Oregon h.), 37.
 freemontii (Frémont h.), 37.
 haematocarpus (red h.), 37.
 repens (creeping h.), 37.
 Oil(s), cedar, 11.
 jojoba, 94.
 resinous, 55.
 wintergreen, 128.
 Oleaceae, 118, 137–138.
 †*Olea oleaster* (wild olive; oleaster), 118.
 †*europaea* (common olive), 118.
 Oleaster. *See* Olive, wild.
 family. *See* Silverberry family.
 Oleoresins, 10.
 †Olive (*Olea*), 118.
 †common (*O. europaea*), 118.
 family, 118, 137–138.
 †wild (*O. oleaster*), 118, 119.
 Olneya tesota (tesota), 86–87, 179.
 Olsen, Orange A., 4.
 Opulaster (ninebark), 7, 57, 180.
 malvaceus (mallow n.), 57.
 pauciflorus, 57.
 Opuntia (chollas; pricklypears), 116–118, 179, 180.
 a. *borescens* (cane-cactus), 117.
 dillei, 116.
 engelmanni (Engelmann pricklypear), 117, 118.
 imbricata. *See* *O. arborescens*.
 sphaerocarpa, 116.
 treleasei, 116.
 †Orach, garden (*Atriplex hortensis*), 27.
 Oregon grape. *See* Hollygrape, Oregon.
 Oregon jay, 65.
 Oreobatus, 58.
 Ornamentals, browse species valuable as, 11, 36, 37, 39, 40, 41, 46, 57, 58, 59, 66, 70, 73, 80, 83, 85, 86, 87, 88, 91, 92, 93, 97, 100, 104, 107, 114, 115, 118, 120, 121, 122, 123, 126, 127, 131, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 148, 149, 150, 152, 153, 156, 165, 166, 170, 179–180.
 Osikakamuk, 164.
 Osmaronia cerasiformis (osberry), 70.
 Osberry (*Osmaronia cerasiformis*), 70.
 Overgrazed range, 5, 31, 32, 37, 39, 50, 60, 66, 67, 68, 69, 72, 76, 83, 85, 86, 108, 109, 114, 115, 120, 144, 150, 157, 158, 160, 161, 163, 164, 170, 171, 172.
 Overgrazing, indicators of, 39, 60, 109, 157, 161, 163, 170, 171.
 resistance to, 170.
 Overstocking, 126, 158, 170.
 Oxalates, 35.
 Oxyccocus; *O. macrocarpus* (cranberry), 133, 136.
 Oxalic acid, 35.
 intermedius, 136.
 oxyccocus, 136.
 oxyccocus intermedius, 136.
 palustris (small c.), 136.
 palustris intermedius (western c.), 136.
 Oxytenia, 8, 155.
 acerosa, 155.
 Pachistima, 97, 98.
 myrsinites (myrtle boxleaf), 98.
 Pachysylla, 25.
 Pachystima. *See* Pachistima.
 Pacific Coast region, 23, 40, 45, 64, 65, 70, 86, 89, 98, 100, 101, 123, 124, 129, 130, 131, 133, 135, 141, 147, 152.
 Padus, 66.
 demissa, 68.
 melanocarpa, 67.
 Palatability, table of, 5.
 Palmer, Edward, 154, 155, 164, 166.
 Palmer, Lawrence J., 15, 18, 19, 131, 136, 183.
 Palmilla, 14.
 Palo amarillo, 36, 55.
 Paloblanco (*Celtis reticulata*), 25.
 (*Zizyphus lycioides*), 113.
 Palo Christo, 80.
 Palo de hierro, 87.
 Paloverde (*Cercidium*), 5, 6, 8, 79, 80.
 (*Canotia holacantha*), 116.
 border (*C. floridum*), 80.
 dwarf, 80.
 littleleaf (*C. microphyllum*), 80.
 Texas (*C. texanum*), 80.
 Pammel, L. H., 11, 37, 45, 67, 73, 84, 85, 86, 89, 104, 105, 107, 113, 118, 122, 131, 133, 142, 143, 145, 146, 147, 150, 157, 158, 166, 185.
 Papilionaceae. *See* Fabaceae.
 Parkinsonia, 8, 79, 80.
 aculeata (Jerusalem-thorn), 79.
 florida, 80.
 microphylla, 80.
 texana, 80.
 torreyana, 80.
 Parosela (peabush), 7, 83–85, 86, 180.
 amoena (desertbeauty), 85.
 argyrea (silver p.), 85.
 formosa (feather p.), 85.
 frutescens (black p.), 85.
 jamesii (James p.), 85.
 johnsoni (desertbeauty), 85.
 parryi (Parry p.), 85.
 pogonantha (bearded p.), 85.
 spinosa (tree-pea), 85.
 spiny, 85.
 tree, 85.
 Parthenium, 179.
 argentatum (guayule), 165.
 incanum (mariola), 165.
 Parthenocissus vitacea (thicket creeper), 114.
 Pasionia densiflora, 19, 20.
 densiflora echinoides, 19.
 Pastures, 60, 89, 170.
 Pavonia, Wright (*Malache lasiopetala*), 114.
 lasiopetala, 114.
 Pea family. *See* Bean family.
 shrubby, 85.
 wild, 69.
 Peabush (*Parosela* spp.), 7, 83–85.
 bearded (*P. pogonantha*), 85.
 black (*P. frutescens*), 85.

Peabush—Continued.

- feather (*P. formosa*), 85.
 James (*P. jamesii*), 85.
 Parry (*P. parryi*), 85.
 silver (*P. argyræa*), 85.
 †Peach (*Amygdalus*; *A. persica*), 66, 69, 70.
 wild, 69, 70.
 Peachbrush (*Emplectocladus*), 69-70.
 Anderson (*E. andersonii*), 70.
 wild, 69, 70.
 †Pear (*Pyrus*), 65.
 Peat, 131, 133.
 Peavine. *See* Pea, wild.
 Pellett, Frank C., 141, 185.
 Pennell, Francis W., 143, 185.
 Pentstemon, 10, 133, 143-144.
 Barrett (*P. barrettæ*), 143.
 barrettæ (Barrett p.), 143.
 breviflorus (stubbyflower p.), 144.
 bush (*P. fruticosus*), 143.
 cliff (*P. rupicola*), 143.
 Davidson (*P. davidsonii*), 143.
 davidsonii (Davidson p.), 143.
 Douglas p. (*P. douglasii*), 143.
 douglasii (Douglas p.), 143.
 fruticosus (bush p.), 143.
 Lemmon (*P. lemmonii*), 144.
 lemmonii (Lemmon p.), 144.
 Lewis (*P. lewisii*), 143.
 lewisii (Lewis p.), 143.
 littleleaf (*P. microphyllus*), 144.
 Lyall (*P. lyallii*), 143.
 lyallii (Lyall p.), 143.
 Menzies (*P. menziesii*), 143.
 menziesii (Menzies p.), 143.
 microphyllus (littleleaf p.), 144.
 Newberry (*P. newberryi*), 143.
 newberryi (Newberry p.), 143.
 rupicola (cliff p.), 143.
 Scouler (*P. scouleri*), 143.
 scouleri (Scouler p.), 143.
 stubbyflower (*P. breviflorus*), 144.
 †Peppertree, California (*Schinus molle*), 95.
 Pepperwood, 39.
 Peraphyllum; *P. ramosissimum* (squaw-apple), 7, 66, 179.
 †*Perisoreus obscurus* (Oregon jay), 65.
 †*Persea americana* (avocado), 38.
 Pests, plant, 53, 55, 89, 111, 114, 116, 123, 163, 168, 178.
 Peterson, Jesse L., 4.
 Peyote (*Lophophora williamsii*), 118.
 Philadelphus (mockorange), 40, 180.
 lewisii (Lewis m.), 40.
 Phlox, false, 139.
 family, 139.
 whorl, 139.
 Phoradendron (mistletoe), 26.
 flavescens (American m.), 27.
 Photosynthesis, 115.
 Phyla (fogfruit), 140.
 Phyllodoce (mountain heath), 132, 180.
 breweri (Brewer m. h.), 132.
 empetriformis (red m. h.), 132.
 glanduliflora (cream m. h.), 132.
 Phymosia, 115.
 Physocarpa, 57.
 Physocarpus, 57.
 Phyto-bezoars, 118.
 Picea (spruce), 11.
 †abies (Norway s.), 11.
 excelsa, 11.
 Pickleweed, 34, 36.
 Pieris mariana (staggerbush), 9.
 Pignut, 94.
 Pinaceæ, 10-12.
 Pinales, 10.
 Pinball, 145.
 Pine (*Pinus*), 10, 11, 49, 100, 134, 176.
 browse value of, 10-11.
 family, 10-12.
 lodgepole, 65, 119, 132, 133, 135, 136, 149.
 reproduction, 107.
 sugar, 25.
 western white, 48.
 western yellow, 21, 25, 43, 48, 49, 50, 53, 55, 57, 65, 66, 68, 85, 87, 98, 100, 105, 109, 119, 123, 124, 137, 142, 148, 149, 150.
 white, 42, 43.
 whitebark, 65.
 yellow. *See* Pine, western yellow.
 Pinemat (*Arctostaphylos nevadensis*), 124.
 Pink, prairie, 177.
 Pinole, 87, 105.
 Piñon (*Pinus edulis*), 2, 3, 11, 22, 37, 39, 50, 55, 70, 91, 96, 97, 111, 122, 137, 140, 141, 148, 155, 176.
 singleleaf piñon (*P. monophylla*), 11.
 Pinus (pine; piñon), 11, 179.
 edulis (piñon), 11.
 monophylla (singleleaf piñon), 11.
 Pioneer species, 97, 109.
 Piper, Charles V., 23, 63, 149, 185, 189.
 Pipsissewa, common (*Chimaphila umbellata*), 179.
 Pistache (*Pistacia*; *P. vera*), 95.
 Mexican (*P. mexicana*), 96.
 Texas (*P. texana*), 96.
 Pistacia (pistache), 95.
 mexicana (Mexican p.), 96.
 texana (Texas p.), 96.
 †vera (pistache), 95.
 Pithecolobium unguis-cati (blackhead), 71.
 Pithecolobium. *See* Pithecolobium.
 Plant succession. *See* Succession, plant.
 †*Pleiocanthus spinosus*, 179.
 †*Pluchea borealis*, 164.
 sericea (arrowweed), 164.
 Plum (*Prunus* spp.), 7, 66, 69.
 †common (*P. domestica*) 66.
 desert, 70.
 Indian, 70.
 Klamath, 69.
 Pacific (*P. subcordata*), 69.
 sand (*P. angustifolia watsoni*), 2.
 Sierra, 69.
 wild (sec. *Prunophora*), 68.
 Plumas National Forest, 146.
 Plume, Apache (*Fallugia paradoxa*), 7, 50-51.
 Poisoning, livestock. *See* Poisonous species.
 Poisonous seeds, 94.
 Poisonous species (of browse plants), 3, 5, 7, 8, 9, 11, 19, 21, 23, 30, 34, 37, 38, 67, 68, 69, 82, 83, 85, 86, 87, 89, 90, 91, 92, 93, 94, 98, 102, 104, 107, 111, 113, 118, 122, 123, 126, 127, 128, 130, 131, 132, 133, 136, 137, 139, 142, 143, 145, 146, 147, 149, 150, 155, 156, 157, 158, 163, 164, 166, 169, 172, 173, 177, 178, 179.
 Polemoniaceæ, 139.
 Peliomnitha, 140.
 Pollen, 19, 102.
 Polycodium, 133.
 Polygala acanthoclada (thorn p.), 93.
 senega (senega-snakeroot), 93.
 spiny (*P. subspinoso*), 93.
 subspinoso (spiny p.), 93.
 thorn (*P. acanthoclada*), 93.
 Polygalaceæ, 93.
 Polygonaceæ, 9, 27.
 Poñil, 50.
 Poplar (*Populus*), 9, 16.
 Populus (poplar; aspen; cottonwood), 9, 16-17.
 aurea, 17.
 tremuloides; *P. tremuloides aurea* (aspen), 17.
 Poreleaf, slender, 166.
 Porophyllum gracile (yerba-del-venado), 166.
 Potash, 86.
 Potassium salts, 35.
 Potato family, 142-143.
 Potentilla fruticosa, 55.
 tenuifolia, 57.
 Potherbs, 27.
 Pott, Emil, 11, 185.
 Prairies, 27. *See* Plains.
 Prantl, K. A. E., 10.
 Prescott National Forest, 73, 94.
 Prickleleaf (*Dysodia acaerosa*), 166.
 Prickles (plant), 116, 118, 146.
 Pricklypear (sec. *Platopuntia*, genus *Opuntia*), 116-118.
 Engelmann (*O. engelmanni*), 117, 118.
 Prien, O. L., 157, 185.

- Privet, false, 137.
swamp, 137.
- Prosopis (mesquite), 3, 8, 71, 73-77, 179.
glandulosa (honey m.), 74-76, 77.
juliflora (common m.), 74, 76-77.
juliflora glandulosa, 74.
juliflora velutina, 76.
odorata, 77.
pubescens, 77.
velutina (velvet m.), 76-77.
- Protective cover, 115, 116.
- Protobalanus (subgenus of *Quercus*), 20, 24.
- Prunus (apricot; cherry; chokecherry; mazzard; plum), 2, 7, 66-69, 179, 180.
andersonii, 70.
angustifolia watsoni (sand plum), 2.
armeniaca (apricot), 66.
avium (mazzard), 66.
cerasus (sour cherry), 66.
demissa (western chokecherry), 68.
demissa melanocarpa, 67.
domestica (common plum), 66.
emarginata (bitter cherry), 69.
emarginata mollis, 69.
emarginata villosa, 69.
fasciculata, 70.
fremontii, 70.
glandulosa, 70.
melanocarpa (black chokecherry), 67-68.
minutiflora, 70.
pennsylvanica (pin cherry), 68.
prunifolia (plumleaf cherry), 68.
subcordata (Pacific plum), 69.
subcordata kelloggii, 69.
virens (Southwestern black cherry), 68-69.
virginiana (common chokecherry), 68.
virginiana demissa, 68.
- Prussic acid, 45, 67, 68.
- Pseudabutilon, 115.
- Pseudotsuga mucronata, 11.
taxifolia (Douglas fir), 11.
- Psoralea, 83, 84.
- Psoraleae, 82.
- Psorodendron, 83.
- Psorothamnus, 83.
- Ptarmiganberry (Mairania alpina), 124.
- Ptelea (hoptree), 91.
trifoliata (common h.), 91.
- Puccinia coronata, 113.
- Purshia, 6, 7, 52-53.
tridentata (bitterbrush), 52-53.
- Pyrola, 48.
- Pyrocoma, 156.
- Pyrus sitchensis, 65.
- Quailbrush, 31.
- Quassia family, 116.
- †Queen-of-the-night (*Selenicereus grandiflorus*), 118.
- Quercus (oak), 3, 19, 20-25, 180.
arizonica (Arizona white o.), 22.
breveri, 23.
californica, 25.
chrysolepis (canyon live o.), 24.
chrysolepis vaccinifolia, 24.
densiflora, 19, 20.
densiflora echinoides, 19.
dumosa (California scrub o.), 22-23.
dumosa turbinella, 23.
echinoides, 19.
emoryi (Emory o.), 25.
fendleri (Fendler o.), 23.
gambelii (Gambel o.), 21, 23, 43, 60.
garryana (Garry o.), 23.
garryana breweri, 23.
grisea (gray o.), 5, 22.
havardii (Havard o.), 23.
kelloggii (California black o.), 25, 107.
novomexicana (New Mexican o.), 21-22.
oerstediana (Brewer o.), 23.
reticulata (netleaf o.), 24.
sadleriana (Sadler o.), 24.
turbinella (shrub live o.), 23.
undulata (wavyleaf o.), 23-24.
utahensis (Utah o.), 21-22.
vaccinifolia (huckleberry o.), 24.
- Quercus—Continued.
virelandii (Vreeland o.), 21-22.
wilcoxii (Wilcox o.), 24.
- Quinine, 121.
- Quinine-bush, 49, 122.
- Rabbit brush (*Chrysothamnus*), 8, 43, 156, 160-163, 169.
(*Aplopappus heterophyllus*), 156.
Bloomer (*Aplopappus bloomeri*), 156.
Douglas (*C. viscidiflorus*), 161-163.
lanceleaf (*C. lanceolatus*), 160-161.
low (*C. viscidiflorus pumilus*), 163.
rubber (*C. nauseosus*), 161.
sawtooth (*C. viscidiflorus serrulatus*), 163.
showy, 161.
spring, 176.
tall (*C. speciosus*), 161, 162.
twistleaf (*C. viscidiflorus tortifolius*), 163.
- Rabbits. See Wild life.
- Rabbitsage, 160, 161.
Douglas, 161.
tall, 161.
- Rafinesque, C. S., 57.
- Ragweed, bur, 153.
family. See Ambrosieae and Ragweed subfamily.
subfamily, or tribe, 153-155.
- Raiford, L. Charles, 157, 185.
- Ramona incana; *R. nivea*, 141.
- Range, cattle, 109, 140.
depleted, 72. See also Overgrazing.
desert, 142, 176. See Deserts.
fall, 52, 113, 169, 173, 175.
goat, 115. See Goats.
lambling, 172, 173. See also Lambling and Lambs.
pests. See Pests, plant.
reconnaissance, 4, 187.
sheep, 53, 115, 134, 140.
spring, 52, 113, 123, 126, 128, 131, 173, 176.
summer, 57, 126, 144, 170.
winter, 45, 52, 113, 120, 142, 169, 175, 176.
- Ranunculaceae, 36.
- Raspberry (*Rubus* spp.), 7, 57, 58.
western red (*R. melanolasius*), 58.
whitebark (*R. leucodermis*), 58.
whiteflowering (*R. parviflorus*), 58.
- Ratany (*Krameria*), 80-82.
family, 7, 8, 80-82.
littleleaf (*K. parvifolia*), 82.
range (*C. glandulosa*), 81, 82.
Texas, 82.
trailing (*K. secundiflora*), 82.
white (*K. grayi*), 82.
- Ravines, 48, 71, 137, 141.
- Rayless-goldenrod, 156, 160.
fetid, 161.
tree, 156.
- Read, Arthur D., 4.
- Reclamation (projects), 34, 169.
- Redbrush, 121.
- Redbud, California (*Cercis occidentalis*), 80.
- Red Desert, 31, 33, 172, 177.
- Redroot, narrowleaf, 109.
- Redshanks (*Adenostoma sparsifolium*), 53-54, 55.
- Redwood, 3, 123, 135.
- Remington, Joseph F., 153, 158, 169, 187.
- Renner, F. G., 4.
- Resin, 115, 116.
- Retama. See Jerusalem-thorn.
- Rhamnaceae, 7, 8, 104-114.
- Rhamnus (buckthorn), 113, 179.
alnifolia (alder b.), 113.
californica (California b.), 113.
cathartica (common b.), 113.
purshiana (cascara), 113, 179.
- Rhatany-root, 80.
- Rhizomes. See Rootstocks.
- Rhododendron, 9, 126, 132-133.
albiflorum, 126.
California, 132.
californicum (coast r.), 132-133, 180.
coast (*R. californicum*), 132-133.
Rocky Mountain, 126.
white-flowered, 126.

Rhoecidium microphyllum, 96, 97. *See* *Rhus* microphylla.
Rhus (sumac), 9, 96-97, 122, 179.
choriophylla, 97.
cismontana (Rocky Mountain s.), 96.
diversiloba, 97.
emoryi (Emory s.), 96-97.
microphylla (litttleleaf s.), 96, 97.
rydbergii, 97.
trilobata (lemonade s.), 96.
utahensis (Utah s.), 96.
virens (evergreen s.), 97.
Ribbon-wood, 54.
Ribes (currant), 40, 41-43, 179, 180.
americanum (American black c.), 43.
aureum (golden c.), 41.
cereum (wax c.), 41, 42.
divaricatum, 40.
inebrians (squaw c.), 41.
inermis, 40.
lobbii, 41.
montigenum (gooseberry c.), 41.
pinetorum (European black c.), 43.
pinetorum, 41.
roezlii, 40.
sanguineum (winter c.), 41.
setosum, 40.
speciosum, 41.
viscosissimum (sticky c.), 41.
watsonianum, 40.
wolfii (Rothrock c.), 42-43.
Ricinella, 93.
Rigg, George B., 188.
Rio Grande region, 80.
River bottoms, 164. *See also* **Bottom** lands.
 valleys, 77. *See also* **Valleys**.
Robbins, W. W., 2, 67, 68, 128, 157, 169, 182, 185.
Robinia (locust), 7, 83, 86, 87, 180.
neomexicana (New Mexican l.), 87, 180.
pseudocacia (black l.), 87.
rusbyi (Rusby l.), 87.
Robsonia speciosa. *See* *Grossularia speciosa*.
Rock, Joseph W., 104, 185.
Rockspirea (*Sericotheca*), 58.
bush (*S. dumosa*), 58.
Rodents. *See* **Wild life**.
Roe, Glenwood C., 113, 152, 156, 184, 189.
Romerillo, 154.
Root (s.), 28, 34, 36, 37, 39, 67, 76, 81, 82, 91, 139, 142, 148, 158, 160, 169, 170, 172, 179.
 medicinal, 160.
 shoots, 123, 124.
 suckers, 67.
Rootstocks, 171, 174.
Rosa (rose), 7, 46-49, 180.
acicularis bourgeauiana (Bourgeau r.), 49.
californica (California wild r.), 49.
cherokeensis, 46.
cglantheria, 46.
engelmannii (Engelmann r.), 48.
fendleri (Fendler r.), 46, 47.
gymnocarpa (bald-hip r.), 47, 48.
laevigata (Cherokee r.), 46.
macounii (Macoun r.), 46-48.
manca (Mancos r.), 46-48.
maximiliani (Maximilian r.), 46-48.
melina (blackstem r.), 49.
nuttana (Nootka r.), 49.
pisocarpa (cluster r.), 48.
pyrifera (pear-hip r.), 49.
trubiginosa (eglantine), 46.
sayi (Say r.), 49.
isidica, 46.
spaldingii (Spalding r.), 49.
spithamaea (ground r.), 49.
ultramontana, 48.
woodsii (Woods r.), 46-48.
Rosaceae, 7, 43-60.
Rose (*Rosa*), 7, 46-49, 68.
 bald-hip (*R. gymnocarpa*), 47, 48.
 blackstem (*R. melina*), 49.
 Bourgeau (*R. acicularis bourgeauiana*), 49.
 California wild (*R. californica*), 49.
 Cherokee (*R. laevigata*), 46.

Rose—Continued.

cluster (*R. pisocarpa*), 48.
 Engelmann (*R. engelmannii*), 48.
 family, 6, 7, 43-60.
 Fendler (*R. fendleri*), 46, 47.
 ground (*R. spithamaea*), 49.
 Macoun (*R. macounii*), 46-48.
 Mancos (*R. manca*), 46-48.
 Maximilian (*R. maximiliani*), 46-48.
 Nootka (*R. nutkana*), 49.
 pear-hip (*R. pyrifera*), 49.
 Say (*R. sayi*), 49.
 Spalding (*R. spaldingii*), 49.
 "wild" (*Rosa* sp.), 46, 133.
 "wild prairie" (*Rosa* sp.), 46.
 Woods (*R. woodsii*), 46-48.
 yellow, 55.
Rose, Frank H., 4.
Rose, J. N., 154, 155, 164, 166, 187.
Rose-bay, California, 132.
Rosemary, wild, 122.
Rothrock, J. T., 185.
Roughage, 117, 118.
Routt National Forest, 126.
Rubiacer parviflorum, 58.
Rubber, 93, 161, 165, 179.
 supply of, 161.
Rubberbush, Mexican, 165.
 New Mexican, 165.
Rubiaceae, 145-146.
Rubus (blackberry-raspberry-dewberry-black-cap-thimbleberry-cloudberry aggregation), 7, 57-58, 179.
leucodermis (whitebark raspberry), 58.
melanolasius (western red raspberry), 58.
nuttanus, 58. *See* *R. parviflorus*.
parviflorus (whiteflowering raspberry), 58.
spectabilis (salmonberry), 58.
strigosus, 58. *See* *R. melanolasius*.
villosus, 179.
Rue family, 91-93.
Rulac, 102. *See* *Acer* (sec. *Negundo*).
Russell, Frank, 82, 185.
Rust, 65.
 crown, 113.
Rutaceae, 91-93, 115.
Rutosma purpurea, 92.
Rydberg, Per Axel, 12, 36, 57, 63, 69, 166, 167, 185, 189.
Ryegrasses. *See* **Wild-ryes** (*Elymus*).
Sacahuista (*Nolina*), 15.
Sadtler, Samuel P., 153, 158, 169, 187.
Safford, William Edwin, 86, 118, 185.
Sage (*Salvia*), 3, 9, 141-142, 153, 155, 165, 167. *See* **Sagebrush** (*Artemisia*); also **Atriplex**, **Chrysothamnus**, **Coleosanthus**, **Eriogonum**, **Eurotia**, **Grayia**, **Hyptis**, **Lep-todactylon**, **Purshia**, and **Trixis**.
 ball, 141.
 bee, 141. *See* **Sage**, white; **Bushmint**, **Emory**.
 black (*S. mellifera*), 141.
 (*Artemisia arbuscula*), 173.
 (*Artemisia tridentata*), 163.
 (*Purshia tridentata*), 53.
 (*Tetradymia canescens inermis*), 177.
 blue, 141. *See* **Sage**, black; **Sage**, desert.
 button, 141.
 (*Artemisia spinescens*), 172.
 Colorado, 167.
 common, 167.
 desert (*S. carnosa*), 141.
 (*Artemisia spinescens*), 172.
 dwarf, 169.
 feather, 31.
 gray, 169.
 hoary, 169.
 horse, 172.
 hunger, 167, 173.
 Mexican, 175.
 mountain, 141, 170.
 old man, 173.
 prickly, 139.
 purple, 141.

Sage—Continued.

- rabbit. *See* Rabbitsage.
 red, 153.
 salt, 28, 30.
 sheep, 27.
 †silver (*S. argentea*), 141.
 silvery, 169.
 slender gray, 173.
 †snowy (*S. nivea*), 141.
 snowy, 141. *See* Sage, whiteleaf.
 spiny, 33, 172.
 sweet, 175.
 wafer, 28.
 white (*S. apiana*), 141.
 (*Artemisia cana*), 169.
 (*Artemisia tridentata*), 167.
 (*Chrysothamnus nauseosus*), 161.
 (*Eurotia lanata*), 31.
 white bee, 141.
 whiteleaf (*S. leucophylla*), 141.
 winter, 31.
 yellow, 161.
- Sagebrush** (*Artemisia*), 2, 3, 8, 33, 34, 39, 43, 50, 53, 68, 96, 137, 139, 141, 158, 166–176.
 alkali (*A. natronensis*), 176.
 big (*A. tridentata*), 34, 167–169, 173.
 Bigelow (*A. bigelovii*), 173.
 bud (*A. spinescens*), 172–173.
 button, 172.
 California (*A. californica*), 173.
 Carruth (*A. carruthii*), 173.
 Colorado, 167.
 common, 167.
 cudweed (*A. gnaphalodes*), 174, 175.
 desert, 172.
 dwarf, 169.
 gray, 169.
 hoary, 169.
 horse, 172.
 low (*A. arbuscula*), 173.
 Mexican, 175.
 mountain, 170.
 New Mexican, 175.
 old man, 173.
 pasture, 170.
 prairie, 175.
 ragweed (*A. franserioides*), 175.
 sand (*A. filifolia*), 175.
 silver (*A. cana*), 169–170.
 silvery, 169.
 slender gray, 173.
 small (*A. nova*), 169.
 spiny, 172.
 stiff (*A. rigida*), 176.
 sweet (*A. incompta*), 175.
 tassel, 173.
 threadleaf, 175.
 threetip (*A. tripartita*), 176.
 wafer, 28.
 white, 161, 167, 169.
 woolly (*A. floccosa*), 175.
 Wright (*A. wrightii*), 176.
- Sageretia wrightii**, 113.
Saguaro. *See* Cactus, giant.
St. Peter's-wort, 149.
Salal (*Gaultheria shallon*), 3, 48, 128, 129, 135.
Salazaria, 140.
Salicaceae, 7, 9, 15–17.
Salicornia (glasswort), 36.
Salix (willow), 3, 9, 15–16, 180.
 argophylla (silverleaf w.), 16.
 barclayi (Barclay w.), 16.
 bebbiana (Bebb w.), 16.
 caespitosa (tufted w.), 16.
 commutata (undergreen w.), 16.
 exigua (narrowleaf w.), 16.
 geyeriana (Geyer w.), 16.
 glaucops (blueback w.), 16.
 monochroma (greensides w.), 16.
 nuttallii, 15.
 saximontana (summit w.), 16.
 scouleriana (Scouler w.), 15–16.
 subcoerulea (blue w.), 16.
 wolfii idahoensis (Idaho w.), 16.

- Salmonberry** (*Rubus spectabilis*), 58.
Sal soda, 31.
Salt, common, 30.
Saltbrush, 33.
Saltbush (*Atriplex*), 8, 27–31, 34.
 †Australian (*A. semibaccata*), 28, 30.
 big (*A. lentiformis*), 31.
 fourwing (*A. canescens*), 28–30.
 Gray's, 33.
 Nuttall (*A. nuttallii*), 31.
 spiny, 30.
Saltgrass (*Distichlis spicata*), 34.
Salts, potassium, 35.
 sodium, 35.
Salt-sage, 30.
Salvia (sage), 3, 9, 140, 141–142.
 apiana (white s.), 141.
 †argentea (silver s.), 141.
 carnosa (desert s.), 141.
 incana, 141.
 leucophylla (whiteleaf s.), 141.
 mellifera (black s.), 141, 179.
 †nivea (snowy s.), 141.
 †polystachya, 141.
 sierra, 170.
 †stachyoides, 141.
Sambucus (elder), 9, 147–149, 179, 180.
 caerulea (blueberry e.), 147–148.
 callicarpa (redberry e.), 149.
 canadensis (American e.), 148, 179.
 canadensis mexicana, 148.
 glauca, 147.
 glauca neomexicana, 148.
 leiosperma, 149.
 melanocarpa (blackbead e.), 149.
 mexicana (Mexican e.), 148.
 microbotrys (bunchberry e.), 149, 179.
 neomexicana (New Mexican e.), 148.
 pubens (scarlet e.), 149.
 †racemosa (European red e.), 149.
 racemosa callicarpa, 149.
 velutina (velvet e.), 148.
 vestita (canyon e.), 148.
Samphire, 36.
Sampson, Arthur W., 4, 10, 16, 17, 107, 149, 152, 161, 185, 186, 189.
Sand binders (erosion control), 89.
 hills, 76.
San Diego region (Calif.), 70.
San Francisco Peaks region, 50.
San Juan tree, 142.
Sandfood, 154.
Sandroot (*Ammobroma sonora*), 154.
San Isabel National Forest, 173.
Santa Fe region (N. Mex.), 175.
Santa Rita region (Ariz.), 85.
Santiam National Forest, 132.
Santonin, 176.
Sapindaceae, 102–104.
Sapindus (soapberry), 104.
 drummondii (western s.), 104, 180.
 marginatus, 104.
 saponaria, 104.
Saponin, 30, 73, 104, 105, 107, 147, 150.
Sarcobatus (greasewood), 8, 34–36.
 baileyi (Bailey g.), 34.
 vermiculatus (greasewood), 32, 34–36, 180.
 vermiculatus baileyi, 34.
Sargent, Charles Sprague, 65, 68, 89, 186.
Sarvis, J. T., 170, 186.
Sarvis. *See* Serviceberry.
 hairy mountain, 62.
Sarvisberry. *See* Serviceberry.
Saskatoon, 60.
Sassafras, 38.
Saunders, A. A., 4.
Scab lands, 176, 179.
Schaffner, J. H., 11.
 †*Schinus molle* (California peppertree), 95.
Schizonotus discolor, 58. *See* Sericotheca.
Schmaltzia affinis, 96. *See* Rhus utahensis.
 emoryi, 96. *See* Rhus emoryi.
 simplicifolia, 96. *See* Rhus utahensis.
 trilobata, 96. *See* Rhus trilobata.

- Schneider, Albert, 12, 54, 71, 84, 91, 109, 118, 131, 143, 146, 169, 170, 172, 173, 179, 186.
 Schoeller, Jacob D., 5.
 Schrader, Heinrich Adolph S., 67.
 Screwbear (Strombocarpa; S. odorata), 8, 77, 78.
 dwarf (S. cinerascens), 77.
 Scrophulariaceae, 10, 143-144.
 Securingea, 93.
 Seed(s), dissemination, 82, 102.
 edible, 11, 34, 87, 94, 96, 105, 107, 141, 179. *See also* Nuts.
 ornamental, 86.
 poisonous, 37, 86, 88, 89, 94, 104, 113.
 Seepweed (Dondia), 36.
 Seepwillow (Baccharis glutinosa), 158.
 †Selenicereus grandiflorus (queen-of-the-night), 118.
 Seneca-snakeroot (Polygala senega), 93.
 Senecio (groundsel), 8, 176.
 filifolius. *See* S. longilobus.
 longilobus, 176.
 spartioides, 176.
 Senecioneae, 176-177.
 Senna family. *See* Cassia family.
 †Sensitiveplant (Mimosa pudica), 8.
 family. *See* Mimosa family.
 Sequoia National Forest, 143.
 Sericotheca (rockspirea), 7, 58-59, 180.
 discolor (creambush), 58, 59.
 discolor ariaefolia (oceanspray), 58, 59.
 dumosa (bush r.), 58.
 Serviceberry (Amelanchier), 7, 43, 46, 50, 53, 60-63, 68, 99, 100, 126, 133, 148, 150.
 alderleaf, 60.
 cluster (A. polycarpa), 62-63.
 common (A. alnifolia), 60-62.
 flowering, 62.
 mountain (A. oreophila), 62.
 Pacific (A. florida), 62.
 redbud (A. rubescens), 63.
 showy, 62.
 Utah (A. utahensis), 63.
 Shadblow, 60.
 Shadscale (Atriplex confertifolia), 8, 30-31, 158.
 (Atriplex canescens), 28.
 Shafer, John Adolph, 187.
 Shantz, H. L., 2, 34, 36, 45, 167, 169, 180, 186.
 Shasta National Forest, 19, 38.
 Sheathflower, 155.
 Sheepberry, 153.
 Shellac, 71, 91.
 Shinn, Charles Howard, 71, 186.
 Shinneries, 20, 23, 24.
 Shittimwood, 113.
 Shoemack, 121.
 Shoemaker, David A., 4.
 Shoestrings, 83.
 Shoots, 67. *See* Root shoots.
 Shreve, Edith B., 164, 186.
 Shrub, buckwheat, 28.
 scurfy, 119.
 strawberry. *See* Strawberry-shrub.
 sweet-scented, 37.
 Sibbaldia, 7.
 Sickness. *See* Poisonous species.
 Sideranthus, 156.
 Sierra Nevada, 19, 23, 50, 53, 55, 65, 102, 105, 107, 108, 109, 123, 126, 128, 131, 133, 135, 150, 169, 177.
 Silage, 14, 15, 89.
 Silk flower (Calliandra), 8, 73.
 Silktassel (Garrya), 121-122.
 Frémont (G. fremontii), 121.
 Goldman (S. goldmanii), 122.
 tree, 122.
 Wright (G. wrightii), 122.
 yellowleaf (G. flavescens), 121.
 †Silkree, 73.
 Silverberry (Elaeagnus commutata), 118-119.
 family, 118-119.
 Silverbush, 118.
 Simaroubaceae, 116.
 Simmondsia californica (jojoba), 5, 9, 94, 95, 103, 111, 179.
 Simsia, 164.
 Siskiyou Mountains, 23.
 Sisters, twin, 146.
 Sitgreaves National Forest, 163.
 Skeletonplant (Lygodesmia), 8, 177-179.
 rush (L. juncea), 178-179.
 thorn (L. spinosa), 179.
 Skeletonweed. *See* Skeletonplant.
 Skin, plants irritant or poisonous to, 97.
 Skunkberry, 146.
 Skunkbush, 131.
 Small, John Kunkel, 189.
 Smith, H. L., 4.
 Smith, Jared G., 15, 27, 28, 30, 33, 34, 154, 170, 175, 186.
 Smith, Leland S., 4, 107, 147, 177.
 Smoke-tree, 85.
 Snake River drainage, 134.
 Snakeroot, white (Eupatorium urticaefolium), 156.
 Snakeweed (Gutierrezia), 8, 163-164.
 (Franseria deltoidea), 154.
 broom (G. sarothrae), 163.
 threadleaf (G. microcephala), 164.
 Sneezeweed tribe, 166.
 Snowball (Viburnum spp.), 153.
 (Cephalanthus occidentalis), 145.
 Snowbell (Styrax), 136.
 California (S. californica), 136.
 family, 136.
 Snowberry (Symphoricarpos spp.), 9, 65, 99, 149-152.
 common (S. albus), 151-152.
 mountain (S. oreophilus), 150-151.
 roundleaf (S. rotundifolius), 152.
 spreading (S. mollis), 152.
 western (S. occidentalis), 152.
 whortleleaf (S. vaccinioides), 152.
 Snowbrush (Ceanothus velutinus), 62, 69, 109, 110, 133.
 Soapberry (Sapindus), 104.
 Drummond, 104.
 family, 102-104.
 western (S. drummondii), 104.
 Soapbloom (Ceanothus spp. sec. Euceanothus), 104, 105, 109, 110.
 Fendler (C. fendleri), 109, 112.
 Martin (C. martini), 109.
 red (C. sanguineus), 110.
 whitebark (C. divaricatus), 109.
 Soap-plant, Indian, 104.
 Soapweed (Yucca elata), 14, 15.
 small (Y. glauca), 14, 15.
 Sodium carbonate, 34.
 chloride, 30.
 salts, 35.
 Soil(s), acid, 9, 65, 121, 122, 130, 132, 133, 136, 172.
 adobe, 34, 165.
 alkali(ne), 8, 28, 30, 31, 32, 33, 34, 35, 36, 142, 155, 156, 157, 160, 161, 163, 172, 176.
 basaltic, 133.
 calcareous, 172. *See* Soils, limestone.
 cindery, 53.
 disintegrated lava, 167.
 granitic, 50, 63, 70, 73, 97, 133, 144, 167.
 gumbo, 30.
 humus, 34, 46, 48. *See* Humus.
 igneous, 50, 55, 167.
 impooverished, 86.
 lava, 167.
 limestone, 50, 55, 88, 97, 98, 100, 103, 104, 167.
 peaty, 57, 131, 133, 136.
 renovators, 86.
 saline, 8, 27, 28, 30, 31, 32, 36, 167.
 serpentine, 133.
 volcanic, 50.
 Solanaceae, 142-143.
 Soopolallie, 119.
 Soopoo-lalia, 119.

- Sophora* (*sophora*; scholar-tree; mescalbean, etc.), 7, 87-89.
secundiflora (mescalbean), 7, 87-89, 180.
Sophora, 89.
Sorbus (mountain-ash), 7, 64-65.
americana (American m.-a.), 65.
 key to species, 64.
occidentalis (alpine m.-a.), 64-65.
sambucifolia (Siberian m.-a.), 64.
scopolina (Greene m.-a.), 64, 65.
sitchensis (Pacific m.-a.), 64, 65.
Sorilla, 91.
Sotol (*Dasyliodon*), 15.
 Texas (*D. texanum*), 15.
Sparhawk, William N., 4, 10, 134, 186.
Spartan, 86.
Sphacele, 140.
Sphaeralcea (globemallow), 115.
Sphagnum, 131.
Spicebush, Arizona, 83.
Spines, 64, 65, 66, 69, 77, 78, 87, 89, 114, 116, 118, 142. See *Thorns*.
Spiraea (*spirea*), 7, 58, 60, 180.
discolor, 58.
discolor dumosa, 58.
dumosa, 58.
menziesii (Menzies s.), 60.
Spirea (*Spiraea*), 7, 49, 58, 60, 99.
Menzies (*S. menziesii*), 60.
Sproat, W. J., 4.
Spruce (*Picea*), 135.
blue, 150.
Engelmann, 98, 132, 149, 150.
Norway (*P. abies*), 11.
Sitka, 128, 131, 135.
Spurge (*Euphorbia* and its segregates, *Chamaesyce*, *Tithymalus*, etc.).
 beetle (*Tithymalus crenulatus*), 93.
 family, 6, 93-94.
 nettle (*Jatropha* spp.), 93.
 Palmer (*T. palmeri*), 93.
Squaw-apple (*Peraphyllum ramosissimum*), 7, 66, 179.
Squawberry, 96.
Squawbush, 96, 111, 121, 142.
 velvet, 96.
Squaw-carpet (*Ceanothus prostratus*), 111.
Ceanothus diversifolius, 107.
Squawthorn, 142.
Staff tree family, 97-98.
Staggerbush (*Pieris mariana*), 9.
 Standardized Plant Names. See *American Joint Committee on Horticultural Nomenclature*.
Standing, Arnold R., 4, 25.
Standley, Paul C., 4, 45, 75, 86, 89, 92, 96, 104, 136, 138, 143, 165, 186, 187, 189.
Stanislaus National Forest, 93.
Starleaf (*Choisya dumosa*), 91, 92.
State Flower.
 Arizona, 118.
 Georgia, 46.
 Idaho, 40.
 Iowa, 46.
 Nevada, 168, 169.
 New Mexico, 118.
 New York, 46.
 North Dakota, 46.
 Oklahoma, 27.
 Oregon, 37.
 Washington, 133.
Steeplebrush, 60.
Steeplebush (*Spiraea* spp.), 60.
Stenolobium incisum, 144.
stans, 144.
Stenotus, 156.
Sterculiaceae, 115.
Stevenson, Matilda Coxe, 12, 154, 164, 186.
Stewart, James O., 4.
Stickerbush, 139.
Stinkweed, 139.
Stipa (needle grass), 161.
columbiana (small n. g.), 161.
minor, 161.
Stizolobium pruriens (cowage), 19.
Stomata, 115.
Storax, California, 136.
 family, 136.
Storm, Earl V., 4, 188.
Strawberry-shrub, 37.
Stream control, 121.
Strombocarpa (screwbean), 8, 77.
cinerascens (dwarf s.), 77.
odorata (screwbean), 77, 78.
pubescens, 77.
Strychnin, 37.
Styracaceae, 136.
Styrax (snowbell), 136.
californica (California s.), 136, 180.
officinalis californica, 136.
Succession, plant, 15, 53, 97, 109, 119, 144.
 climax type, 15, 169.
 pioneer species, 97, 109.
Sudworth, George B., 10, 21, 23, 25, 63, 67, 77, 79, 80, 87, 98, 104, 137, 186.
Sumac (*Rhus*), 9, 96-97.
Emory (*R. emoryi*), 96-97.
evergreen (*R. virens*), 97.
 family, 95-97. See *Anacardiaceae* and *Cashew* family.
lemonade (*R. trilobata*), 96.
littleleaf (*R. microphylla*), 96, 97.
poison (*Toxicodendron vernix*), 97.
Rocky Mountain (*R. cismontana*), 96.
sweet-. See *Sweet-sumac*.
three-lobed, 96.
Utah (*R. utahensis*), 96.
Sunflower, desert, 164.
 tribe, 164-166.
Supplemental feeding, 34.
Suwarro. See *Saguaro*.
Svida, 119.
stolonifera riparia, 121.
Sweetbrier, 46.
Sweetbrush, 43.
Sweet cicely, 65.
Sweetpotato, 154.
Sweet-scented shrub, 37.
Sweetshrub (*Calycanthus*), 37-38.
 California (*C. occidentalis*), 37-38.
 family, 37-38.
Sweet-sumac, 96.
Swine, 21, 76, 102.
Symphoricarpos (snowberry; coralberry), 9, 149-152, 180.
albus (common s.), 150, 151-152.
mollis (spreading s.), 150, 152.
occidentalis (western s.), 152.
oreophilus (mountain s.), 150-151.
racemosus. See *S. albus*.
rotundifolius (roundleaf s.), 152.
vaccinioides (whortleleaf s.), 151, 152.
Syringa, 40.
 wild, 40.
Tahoe National Forest, 107.
Talbot, M. W., 4, 51.
Tanbark, 123.
 dwarf, 19.
Tanglebush, 137.
Tannic acid, 21, 22, 23.
 poisoning, 23.
Tannin, 9, 22.
Tanning, 22, 71, 96.
Tanoak (*Lithocarpus*; *L. densiflora*), 19-20.
 scrub (*L. densiflora echinoides*), 19-20.
Tansybush (*Chamaebatiaria millefolium*), 55.
Taparosa, 144.
Tar-bush (*Flourensia cernua*), 165.
(Chamaebatiaria foliolosa), 55.
Tarragon, false (*Artemisia dracunculoides*), 173-174.
Tarweed, 55.
Tasajillo (-a) (*Opuntia* spp.), 116.
Tasseltree, 122.
Taste, qualities of, 6, 9, 27, 28, 34, 37, 50, 53, 57, 64, 66, 68, 69, 70, 91, 93, 96, 105, 107, 119, 121, 122, 128, 133, 145, 156, 160, 161, 165, 169, 175.
Taxaceae, 10.
Taxin, 12.

Taxodiaceae, 10.
Taxus (yew), 11-12.
 baccata (English y.), 11-12.
 brevifolia (Pacific y.), 12.
 canadensis (Canada y.), 12.
 Taylor, C. E., 4.
 †Tea, 57, 131.
 Alaska, 131.
 Brigham, 12.
 substitutes, 57, 131.
 teamsters', 12.
 wild, 83.
 Tea-tree, Oregon, 110.
 Duke of Argyll's, 142.
Tecoma stans (trumpetbush), 144, 180.
 Terpenes, 10.
Tesota (*Olneya tesota*), 86-87.
Tetracoccus, 93.
Tetradymia (horsebrush), 8, 176-177.
 axillaris (longspine h.), 177, 178.
 canescens inermis (spineless h.), 177, 178.
 glabrata (littleleaf h.), 176-177, 180.
 inermis, 177.
 longispina, 177.
 nuttallii (Nuttall h.), 177.
 spinosa (shortspine h.), 177.
 Texas, Panhandle region, 23.
Thamnosma (desert-rue), 91-93.
 montana (Mohave d.-r.), 91-92.
 texana (Texas d.-r.), 92-93.
Thimbleberry (*Rubus* spp.), 7, 57, 58, 60, 106-107, 133. *See* Raspberry, whitedowering.
 western, 58.
 Thistle, Scotch, 89.
 Thompson, Robert, 4.
 Thorn(s), 49, 58, 63, 69, 71, 79, 116. *See* Spines.
 broom, 89.
 bush, 179.
 cotton, 177.
 crucifixion, 116.
 desert, 142.
 rabbit, 142.
 Thorn-apple, short-spined, 63.
 Thornber, John James, 82, 94, 156, 186, 187.
 Thorny bill, 25.
 Thoroughwort, snow, 156.
 Three-awn, 82.
Thurberia, 114-115.
 shrubby (*T. triloba*), 114.
 thespesioides, 114.
 triloba (*shrubby t.*), 114.
 Thymophylla, 165.
 Tidelands, 147.
 Tidestrom, Ivar, 4, 27, 63, 187.
 Timber, 87, 138. *See also* Types, timber.
 Timothy, 172.
Tithymalus (spurge), 93.
 crenulatus (beetle s.), 93.
 palmeri (Palmer s.), 93.
 Tlapalezpatli, 86.
Tobacco (*Nicotiana*), 142-143.
 tree (*N. glauca*), 142-143.
 Tobacco-brush, 109.
 Tobosa-grass, 165.
 Tohafs, 164.
 Tomatilla (-o), 142.
 Tonestus, 156.
Tonic(s), 164, 169, 175.
 cow, 175.
 properties, 169.
 Tonto Creek, 37.
 Tonto National Forest, 37.
 Tornillo, 77. *See* Screwbean.
 Tourneford, Joseph Pitton, 118.
Toxicodendron (poison ivy; poison oak; poison sumac), 96, 97, 180.
 diversilobum (p. o.), 97.
 rydbergii (western p. i.), 97.
 vernix (poison sumac), 97.
 Toyabe Mountains, 27.
 Transpiration, browse devices to retard, 123, 164.
 Tree, bore, 149.
 button, 145.
 cajeput, 39.
 California bay, 39.

Tree—Continued.
 groundsel, 158.
 gutter, 121.
 of Christ, 116.
 San Juan, 142.
 spice, 39.
Treebire (*Cissus incisa*), 114.
Tree-huckleberry (*Batodendron* spp.), 133.
Treemallow (*Lavatera*), 115.
 California (*L. assurgentiflora*), 115.
Tree-pea (*Parosela spinosa*), 85.
 Trefoil, shrubby, 91.
 Trelease, William, 20, 21, 187.
 Tremetol, 156.
 Trichostema, 93.
 Trinity Mountains, 23.
Trixis, American (*T. californica*), 153.
 angustifolia, 153.
 californica (American t.), 153.
 suffruticosa, 153.
 Tronadora, 142.
Trumpetbush (*Tecoma stans*), 144.
 Trumpet creeper family, 144.
 Tunas, 118.
 Turner, W. F., 117, 187.
Turnera aphrodisiaca. *See T. diffusa*.
 diffusa (damiana), 166.
 Twinberry, 138, 146.
 red, 147.
Twinflower (*Linnaea*), 48, 146.
 American (*L. borealis americana*), 146.
 Twinfruit, 138.
 Twirling sticks, 169.
 Two-eyed berries, 146.
Type(s). *See also* Formations and Zones.
 alpine, 41, 124, 126, 128, 132, 134, 167.
 arctic-alpine, 64, 121, 124, 126, 130.
 See also Type(s), alpine.
 aspens, 109, 119, 148, 150, 169, 173.
 blackbrush, 55.
 bluffs, ocean, 39.
 browse. *See* Type(s), brush.
 brsh, 37, 43, 46, 48, 50, 55, 60, 62, 68, 69, 99, 100, 109, 111, 124, 137, 140, 166, 169. *See also* Chaparral.
 brush-annuals, 164.
 catclaw, 37.
 chaparral. *See* Chaparral.
 climax, 15.
 conifer. *See* Conifers; Type(s), mixed conifer.
 coveillea. *See* Type(s), creosote bush.
 coveillea-mesquite. *See* Type(s), mesquite-coveillea.
 creosote bush, 2, 71, 89, 94, 96, 97, 111, 137, 140, 141, 144, 154, 156, 158.
 desert. *See* Deserts.
 Douglas fir, 100, 123, 128, 135, 150.
 See also Type(s), western yellow pine—Douglas fir.
 Engelmann spruce, 98, 132, 149, 150, 169, 173.
 fire, 107.
 foothill. *See* Foothills.
 grama, 164.
 grass, 76, 169, 173.
 grass-brush, 142, 166.
 grass-weed, 33, 145, 155, 157, 158, 161.
 greasewood, 2.
 juniper, 66, 139, 158. *See also* Type(s), piñon-juniper.
 juniper-piñon. *See* Type(s), piñon-juniper.
 lacustrine (lake shore), 57, 175.
 live oak, 123.
 lodgepole pine, 65, 119, 132, 133, 135, 136, 149.
 meadow, 40, 57, 120, 134, 135.
 mesa, 27, 50, 71, 82, 116, 138, 140, 165, 167.
 mesquite, 71, 85.
 mesquite-catclaw, 82.
 mesquite-coveillea, 85, 113, 154, 165.
 mixed conifer, 25, 48, 55.
 mountain-mahogany, 45, 158.

Type(s)—Continued.

- oak brush, 96, 144, 158.
- oak—mountain-mahogany—grama, 138.
- park, 137, 176.
- park—weed, 169.
- pine, 49, 134.
- piñon, 96, 140, 148, 175. *See also*
- Type(s), piñon-juniper.
- piñon—juniper, 2, 22, 37, 50, 55, 70, 91, 96, 111, 122, 137, 141, 155.
- piñon—oak brush, 97.
- plains. *See* Plains.
- redwood, 123, 135.
- riparian (streambank), 37, 39, 41, 49, 121, 161, 164.
- sagebrush, 2, 33, 96, 137, 139, 141, 161, 167, 169, 175.
- sagebrush—shadscale, 158.
- scabland, 176, 179.
- semidesert, 70, 71, 111, 137.
- Sitka spruce, 128, 131, 135.
- spruce, 135, 169, 173.
- subalpine, 22, 57, 126, 128, 132, 134, 149.
- subalpine—alpine, 64, 119, 132, 143.
- subclimax, 161.
- tar-bush, 165.
- timber, 68, 87, 147.
- timber line, 64.
- transition, 53.
- weed, 68, 69, 111.
- western larch, 132.
- western yellow pine, 21, 22, 43, 48, 49, 50, 53, 55, 57, 65, 66, 85, 87, 100, 105, 109, 119, 123, 124, 137, 142, 148, 149, 150, 166, 169, 173, 175, 176.
- western yellow pine—Douglas fir, 98.
- wheatgrass, 161.
- whitebark pine, 65.
- white fir, 24.
- willow, 146.
- woodland, 22, 24, 43, 50, 62, 85, 88, 89, 92, 104, 114, 119, 122, 124, 137, 138, 140, 142, 164, 166, 169, 176.
- yellowbrush (rabbit brush)—needle grass, 161.
- yellow pine. *See* Type(s), western yellow pine.
- yellow pine—Douglas fir. *See* Type(s), western yellow pine—Douglas fir.
- Uinta Mountains, 49, 163, 173.
- †*Ulex europaeus* (gorse), 89, 179.
- Ulm, 89.
- Ulmaceae, 25–26.
- Umatilla National Forest, 146.
- Umbellularia californica** (California-laurel), 39, 179.
- Umpqua National Forest, 70.
- Uña de gato, 79.
- Ungnadia**, 102, 104.
- speciosa (Mexican-buckeye), 104, 180.
- United States Dispensatory, 37, 153, 158, 169, 187.
- United States Pharmacopoeia, 153.
- Vacciniaceae, 9, 133–136.
- Vaccinium** (blueberry; whortleberry; cowberry), 3, 133–136, 179.
- angustifolium (dowbush b.), 134.
- arbuscula. *See* V. cespitosum arbuscula.
- caespitosum. *See* V. cespitosum.
- canadense (Canada b.), 134.
- caespitosum (dwarf w.), 134.
- caespitosum arbuscula, 134.
- deliciosum (timber-line w.), 134.
- erythrococcum. *See* V. scoparium.
- macrocarpum. *See* Oxyccoccus macrocarpum.
- macrophyllum. *See* V. membranaceum.
- membranaceum (big w.), 133–134.
- microphyllum, 135.
- myrtillus, 135.
- myrtillus microphyllum, 135.
- occidentale (western bog b.), 134–135.
- oreophitum (Rocky Mountain w.), 135.
- ovalifolium (blue w.), 135.
- ovatum (box b.), 135.
- oxyccoccus. *See* Oxyccoccus palustris.

Vaccinium—Continued.

- oxyccoccus intermedium. *See* Oxyccoccus palustris intermedium.
- parvifolium (red w.), 135.
- pennsylvanicum, 134.
- pennsylvanicum angustifolium, 134.
- scoparium (grouse w.), 135–136.
- vitis-idaea (cowberry), 136.
- vitis-idaea minor (mountain cranberry), 136.
- Vagnera, 69.
- Valleys (or valley lands), 51, 64, 65, 71, 77, 96, 100, 102, 141, 164.
- Vansell, G. H., 102, 187.
- Vasey, George, 154, 155, 164, 166, 187.
- Vauquelinia, 7.
- Vawter, L. R., 68, 177, 182, 188.
- Verbenaceae, 140.
- Verde River, 105.
- Viborquia orthocarpa**, 86.
- polystachya, 86.
- Viburnum**, 152–153, 179, 180.
- americanum, 153.
- ellipticum (Oregon v.), 152.
- lentago (nananberry), 153.
- †*opulus* (European cranberrybush), 153.
- opulus americanum, 153.
- Oregon (V. ellipticum), 152.
- pauciflorum (rayless cranberrybush), 153.
- sweet, 153.
- trilobum (American cranberrybush), 153.
- †*Vicia faba*, 79.
- Viehoever, Arno, 176, 187.
- Viguiera, 8, 165.
- helianthoides, 165.
- parishii, 165.
- stenoloba, 165.
- tenuifolia, 165.
- texana, 165.
- Vinall, H. N., 189.
- Vine(s), deer, 146.
- ground, 146.
- Jackson, 142.
- woody, 1, 36, 97, 114, 146.
- Viorna, 36.
- Vitaceae, 114.
- Vitis (grape), 179.
- Vitis-idaea. *See* Vaccinium.
- Viznaga. *See* Cactus, Arizona water.
- Wahoo**, eastern (*Euonymus atropurpureus*), 97.
- western (*E. occidentalis*), 97.
- Wallowa Mountains, 16.
- Walnut (*Juglans* spp.), 179.
- Waltheria americana, 115.
- Walton, G. P., 76, 187.
- Wasatch Mountains, 25, 32, 43, 49, 58, 64, 161, 172.
- Watercourses, 12, 49, 104, 114, 137, 142, 144, 145.
- Waterleaf family, 139–140.
- Watershed protection, 24.
- Water sources (or supply), 97, 116, 118.
- Water-wally, 158.
- Watson, Sereno, 65, 91, 181, 189.
- Wax, 115.
- Waxberry, 149, 150.
- Waxmallow**, Drummond (*Malvaviscus drummondii*), 114.
- Waxmyrtle** (*Myrica* spp.), 179.
- Weed(s), chill, 158.
- locust, 179.
- pestiferous, 179.
- range, 53, 115.
- Weevil, wild cotton boll, host of, 115.
- Wenaha National Forest. *See* Umatilla National Forest.
- Wenatchee Mountains, 18.
- National Forest, 58, 63, 132.
- region (Wash.), 63.
- Weyl, Leon H., 149, 186.
- Wheatgrass, 32, 148, 169.
- Whin, 89.
- Whipplea modesta** (whipplea; modesty), 40.
- White pine blister rust, 42, 43.
- Whitebrush, 105.
- Whitebush, 164.

- Whitethorn** (*Ceanothus cordulatus*), 108-109.
(Zizyphus lycioides), 113.
- Whitham**, James C., 4.
- Whortleberry** (*Vaccinium* spp.), 133-134, 135, 136.
 big (*V. membranaceum*), 133-134.
 blue (*V. ovalifolium*), 135.
 dwarf (*V. cespitosum*), 134.
 grouse (*V. scoparium*), 135-136.
 red (*V. parvifolium*), 135.
 Rocky Mountain (*V. oreophilum*), 135.
 timber-line (*V. deliciosum*), 134.
- Wichita National Forest**, 82.
- Wilcox**, E. V., 67, 179, 181.
- Wild almond**, **Torrey** (*Emplectocladus fasciculatus*), 70.
- Wild life** (relation to browse spp.), 4, 25, 98. *See also* Fruits.
 antelope, browse of, 51, 52, 53, 177.
 bears, berries cropped by. *See* Fruits.
 use of mast by, 21, 24.
 birds (doves, grouse, jays, ptarmigan, quail, wild pigeons, wild turkeys, etc.),
 as agents of seed dissemination, 102.
 browse of, 80.
 flowers eaten by, 127, 132.
 seeds edible to, 94.
 caribou, browse of, 136.
 deer (including mule deer).
 browse of, 17, 21, 87, 94, 107, 109, 124, 150.
 spring browse, 52, 53, 58, 100.
 winter browse, 45, 50, 52, 53.
 covert for, 109.
 spp. poisonous to, 11.
 use of mast by, 24.
 elk, spring browse of, 100.
 winter browse of, 33, 170, 171.
 moose, browse of, 18.
 rodents (jack rabbits, kangaroo rats, squirrels, etc.).
 browse of, 118, 154.
 cover for, 71.
 seeds edible to, 94.
 spp. poisonous to, 11, 158.
 species having medicinal effect on, 176.
- Wild-rye**, 176.
- Wiley**, Harvey W., 37.
- Willey**, J. A., 4.
- Williams**, R. H., 189.
- Willow** (*Salix*), 2, 9, 15-16, 46, 49, 62, 63, 100, 119, 121, 126, 146, 147.
 Barclay (*S. barclayi*), 16.
 beak, 16.
 Bebb (*S. bebbiana*), 16.
 black, 15.
 blue (*S. subcoerulea*), 16.
 blueback (*S. glaucops*), 16.
 button, 145.
 desert. *See* Desertwillow.
 false, 144, 158.
 family, 7, 9, 15-17.
 fire, 15, 128.
 Geyer (*S. geyeriana*), 16.
 Gila, 158.
 greensides (*S. monochroma*), 16.
 Idaho (*S. wolfii idahoensis*), 16.
 mountain, 15.
 narrowleaf (*S. exigua*), 16.
 Nuttall, 15.
 Rocky Mountain, 16.
 Scouler (*S. scouleriana*), 15-16.
 silverleaf (*S. argophylla*), 16.
 stinking, 83.
 summit (*S. saximontana*), 16.
 tufted (*S. caespitosa*), 16.
 undergreen (*S. commutata*), 16.
 water, 158.
- Wilson**, C. P., 28, 30, 182, 187.
- Wilson**, Nathaniel E., 41, 48, 61, 68, 187.
- Wind**, seed dissemination by, 102.
 erosion, 12, 14, 160.
- Wind River district** (Wyo.), 175.
- Wintercreeper**. *See* *Euonymus*.
- Winter fat** (*Eurotia*; *E. lanata*), 8, 31-33, 34.
- Wintergreen** (*Gaultheria*; *G. procumbens*), 105, 128.
 bush (*G. ovatifolia*), 128.
 oil of, 128.
 western (*G. humifusa*), 128.
- Wissadula**, 115.
- Wolfberry**, **Frémont** (*Lycium fremontii*), 142.
 pale (*L. pallidum*), 142.
(Symphoricarpos spp.), 149.
- Wood**. *See* Fuel; Fence posts.
- Wood**, Geo. B., 153, 158, 169, 187.
- Wood**, Horatio C., 153, 158, 169, 187.
- Wood**, Horatio C., jr., 153, 158, 169, 187.
- Woodhead**, Philip V., 4.
- Woods**, C. N., 4, 63.
- Woodward**, T. E., 117, 187.
- Wooten**, E. O., 12, 30, 33, 36, 165, 180, 187, 189.
- Work**, Herman, 4.
- Wormwood** (*Artemisia*), 153, 167, 170.
 American, 170.
 bud, 170.
 common (*A. absinthium*), 172.
 fringed, 170.
 Louisiana (*A. ludoviciana*), 175.
 Mexican (*A. mexicana*), 175-176.
 New Mexican (*A. neomexicana*), 175-176.
 oil of, 172.
- Wyman**, Lenthall, 4.
- Xylorrhiza** (woody aster), 157, 158, 180.
glabriuscula, 157-157. *See* *Aster glabriusculus*.
- parryi*, 157, 180. *See* *A. parryi*.
- Xylosteon**, 146. *See* *Lonicera*.
involutatum, 147.
ledebourii, 147.
utahense, 147.
- Yarrow**, 169.
- Yates**, Harry S., 4, 67, 130, 143, 183.
- Yellowbrush**, 157, 160, 161.
 Douglas, 161.
 dwarf, 160.
 rubber, 161.
- Yellowstone National Park**, 132.
- Yerba buena**, 146.
- Yerba del bucy**, 114.
- Yerba del pismo**, 53-54.
- Yerba-del-venado** (*Porophyllum gracile*), 166.
- Yerba-de-pismo** (*Baccharis ramulosa*), 158, 159.
- Yerba santa** (*Eriodictyon*), 139-140.
 California (*E. californicum*), 140.
 narrowleaf (*E. angustifolium*), 140.
- Yew** (*Taxus*), 11-12, 132.
 Canada (*T. canadensis*), 12.
 †English (*T. baccata*), 11-12.
 family, 10.
 Pacific (*T. brevifolia*), 12, 63, 126.
- Yucca**, 14-15, 179.
 angustifolia, 14.
 elata (soapweed), 14.
 glauca (small soapweed), 14-15.
 soaptree, 14.
 soapweed, 14.
- Yucca family**. *See* Dragon-tree family.
- Yukon**, 60, 64.
- Zizyphus** (jujube), 111, 113-114, 179. *See also* *Condalia*.
 †*jujuba* (common j.), 113.
 lycioides (Southwestern j.), 113-114.
 lycioides canescens, 113.
 obtusifolia (Texas j.), 114.
 parryi (Parry j.), 114.
 sativa, 113. *See* *Z. jujuba*.
 vulgaris, 113. *See* *Z. jujuba*.
- Zon**, Raphael, 2, 186.
- Zone(s)**. *See also* Formations and Types.
 Arctic-alpine, 54, 121, 124, 126, 130.
 Canadian, 65.
 Hudsonian, 64, 65.
 Lower Sonoran, 71, 89, 90, 140.
 tension, 43.
 Transition, 53, 65, 176.
 Upper Sonoran, 91, 140, 176.
- Zorillo**, 91.
- Zygia unguis-cati**, 71.
- Zygophyllaceae**, 89-91.

ORGANIZATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE WHEN THIS PUBLICATION WAS LAST PRINTED

<i>Secretary of Agriculture</i>	ARTHUR M. HYDE.
<i>Assistant Secretary</i>	R. W. DUNLAP.
<i>Director of Scientific Work</i>	A. F. WOODS.
<i>Director of Regulatory Work</i>	WALTER G. CAMPBELL.
<i>Director of Extension Work</i>	C. W. WARBURTON.
<i>Director of Personnel and Business Admin- istration.</i>	W. W. STOCKBERGER.
<i>Director of Information</i>	M. S. EISENHOWER.
<i>Solicitor</i>	E. L. MARSHALL.
<i>Weather Bureau</i>	CHARLES F. MARVIN, <i>Chief.</i>
<i>Bureau of Animal Industry</i>	JOHN R. MOHLER, <i>Chief.</i>
<i>Bureau of Dairy Industry</i>	O. E. REED, <i>Chief.</i>
<i>Bureau of Plant Industry</i>	WILLIAM A. TAYLOR, <i>Chief.</i>
<i>Forest Service</i>	R. Y. STUART, <i>Chief.</i>
<i>Bureau of Chemistry and Soils</i>	H. G. KNIGHT, <i>Chief.</i>
<i>Bureau of Entomology</i>	C. L. MARLATT, <i>Chief.</i>
<i>Bureau of Biological Survey</i>	PAUL G. REDINGTON, <i>Chief.</i>
<i>Bureau of Public Roads</i>	THOMAS H. MACDONALD, <i>Chief.</i>
<i>Bureau of Agricultural Economics</i>	NILS A. OLSEN, <i>Chief.</i>
<i>Bureau of Home Economics</i>	LOUISE STANLEY, <i>Chief.</i>
<i>Plant Quarantine and Control Administration</i>	LEE A. STRONG, <i>Chief.</i>
<i>Grain Futures Administration</i>	J. W. T. DUVEL, <i>Chief.</i>
<i>Food and Drug Administration</i>	WALTER G. CAMPBELL, <i>Director of Regulatory Work, in Charge.</i>
<i>Office of Experiment Stations</i>	JAMES T. JARDINE, <i>Chief.</i>
<i>Office of Cooperative Extension Work</i>	C. B. SMITH, <i>Chief.</i>
<i>Library</i>	CLARIBEL R. BARNETT, <i>Librarian.</i>

This publication is a contribution from

<i>Forest Service</i>	R. Y. STUART, <i>Chief.</i>
<i>Branch of Research</i>	EARLE H. CLAPP, <i>Assistant For- ester, in Charge.</i>
<i>Division of Range Research</i>	W. R. CHAPLINE, <i>in Charge.</i>

